OIPE
OCT 1 8 2004
PATENT & TRADEMARK OFFICE

IFW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Mark E. MALONE et al.

Application No.: 10/780,182

Filed: February 17, 2004

For: FROZEN AERATED PRODUCT

Confirmation No.: 9861

Group Art Unit: 1761

Examiner: Maureen C. Donovan

RECEIVED
OCT 2 1 2004
TC 1700

THIRD-PARTY SUBMISSION OF PRIOR ART

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

In accordance with 37 C.F.R. § 1.99(a), and acting as a member of the public, I would like to submit for consideration by the Examiner and entry into the file of this application the enclosed patents and publications. Further in accordance with 37 C.F.R. § 1.99(b), a list of patents and publications, including the dates of each, is provided herewith.

Patents/Applications:

Document	Issue or Publication Date	Country and Type
6,558,729	5/6/2003	US patent
2003/3215	1/2/2003	US appln.
4,724,153	2/9/1988	US patent
4,244,977	1/13/1981	US patent
1321043A1	6/25/2003	EP appln.
20202557.8	7/25/2002	Translation of DE utility model appln.
0147483A1	7/12/1985	EP appln.

OK to enter as modified explanations deleted 11/15/04

10/19/2004 HVUONG1 00000131 501814 10780182

01 FC:1806 180.00 DA

A

Other Publications:

Operating Instructions: FRESH UP Ice Bandit; Nestle -

Arbuckle; Ice Cream, 4th Ed.; 1986

Jackson, E.B., Howling, D.; Sugar Confectionery Manufacture: Glucose syrups and starch hydrolysates, 2nd Ed.; 1995 -

This submission was also duly served upon the attorney of record for the applicants by first class mail, certified and return receipt requested, on October 18, 2004. A fee of $180 is believed to be required in connection with this filing. Please charge the required fee to Winston & Strawn LLP Deposit Account No. 50-1814.

Respectfully submitted,

10/18/04
Date

Jeffrey A. Wolfson
Jeffrey A. Wolfson (Reg. No. 42,234)

WINSTON & STRAWN LLP
Customer No. **28765**

202-371-5770

1.8 Conclusion

It has been possible, in one chapter, to present only a short introduction to the industry's basic ingredient, since sugar is a very widely studied material. Several societies and journals are devoted exclusively to its study and countless books written about it. An attempt has been made to highlight those aspects of most use to the confectioner but, for more extensive coverage, the reader is referred to the bibliography.

Bibliography

Sugar: Science and Technology. Applied Science Publishers. London. (1979) G.G. Birch and K.J. Parker.
Technology for Sugar Refinery Workers. Chapman & Hall. (1970) O. Lyle.
Handbook of Sugars. AVI Publishing. (1973) W.R. Junk and H.M. Pancoast.
Principles of Sugar Technology. Elsevier Publishing. (1953) P. Honig.
Cane Sugar Handbook. John Wiley & Sons. (1993) J.C.P. Chen and C.C. Chou.
Beet-Sugar Technology. Beet Sugar Development Foundation. (1982) R.A. McGinnis.
International Commission for Uniform Methods of Sugar Analysis: Methods Book. ICUMSA Publications Department. (1994).

2 Glucose syrups and starch hydrolysates

E.B. JACKSON and D. HOWLING

2.1 Introduction

Glucose syrups or corn syrups have long been used as key ingredients in the confectionery industry, and their properties have been presented many times.[1] The objective of this current review is to bring that knowledge up to date, as many interesting developments in this area are being made for the food industry in general and the confectionery industry in particular.

Glucose syrups are defined by the EEC and *Codex Alimentarius* as follows:

EEC

Glucose syrup is a refined, concentrated aqueous solution of D (+)-glucose, maltose and other polymers of D-glucose obtained by the controlled partial hydrolysis of edible starch.

Codex

Glucose syrup is a purified concentrated aqueous solutions of nutritive saccharides obtained from starch.

Thus the origin of glucose syrups is starch. In Europe maize starch is the most common source of starch though potato and wheat starch are also used.

Whatever the source of the starch it comprises two distinct fractions: amylose, in which the anhydroglucopyranose units are linked exlusively in the 1–4 positions, giving a linear molecule, and amylopectin, which is branched due to the presence of 1–6 links. The molecular weight and ratio of these two fractions determine the rheological properties of the starches but have only a limited effect on the hydrolysis of starch. High-amylopectin starches yield better clarity in very low-DE (dextrose equivalent) maltodextrins, but otherwise the glucose properties are similar.

Today major advances are being made by the use of enzymes and this is discussed in Section 2.2, but first let us consider the technology available before the use of enzymes, which so far as glucose syrups are concerned, is 30 years ago. Then starch was hydrolysed by the use of mineral acids, usually in batch converters, though more recently by continuous processes. In either case starch was mixed with mineral acid. Sulphuric acid was used for some time, but the problems with insoluble sulphates led to the use of hydrochloric

Table 2.1 Sugar composition of acid-converted glucose syrups

Glucose syrup	Dextrose equivalent			
	30	34–36	42–43	55
Dextrose	10	13.5	19	31
Maltose	9	11.5	14	18
Maltotriose	10	10	12	13
Maltotetraose	8	9	10	10
Maltopentaose	7	8	8	7
Maltohexaose	6	6	7	5
Maltoheptaose	5	5.5	5	4
Higher sugars	45	36.5	25	12

acid. This placed constraints on the materials of construction, but the use of high grades of stainless steel led to commercial processes.

Acid hydrolysis used alone, however, suffered from a major failing in terms of product range. Between 30 and 55 DE, products of the high quality demanded by the food and confectionery industry could be, and still are, produced, but even within this range, no control could be exercised over the relative levels of specific saccharides. Carbohydrate distribution was reproducible, but solely a function of DE (see Table 2.1).

At DEs below 30, the essentially random nature of acid hydrolysis does not allow the chain length of the linear starch fractions to be sufficiently reduced to give clear, non-retrograding solutions. Such fractions, together with those created by the scission of 1–6 linkages, reassociate to form haze-producing, insoluble crystallites. At the other extreme, for DEs above 55, undesirable side reactions occur due to the more stringent conditions of acid concentration, temperature or time required. Fission of the glucopyranose ring produces colour precursors such as hydroxymethyl furfural, while bitter compounds are formed by repolymerisation.

2.2 Enzymes in glucose syrup production

How then have enzymes improved the range of glucose syrups available to the confectioner?

2.2.1 *Specificity*

First of all enzymes give specificity. Provided that the glucose manufacturer could produce a soluble non-retrograding starch substrate at 60°C, he/she could avail him/herself of amylolytic activity to produce starch hydrolysates of controlled/tailored sugar distribution. The need to use mineral acid was not initially avoided because this was used to provide the non-retrograding substrate and a series of acid/enzyme syrups was created (see Table 2.2).

Table 2.2 Sugar composition of acid/enzyme syrups

Type	High maltose		High conversion (Amyloglucosidase)	
DE	42	48	63	70
Dextrose	6	9	37	43
Maltose	45	52	32	30
Maltotriose	12	15	11	7
Maltotetraose	3	2	4	5
Maltopentaose	2	2	4	3
Maltohexaose	2	2	3	2
Higher sugars	30	18	9	10

Maltogenic enzymes of fungal or vegetable origin could be used to enhance the content of maltose, these high-maltose syrups finding applications in confectionery and brewing. Co-incubation with microbial amyloglucosidases led to the production of sweeter, more highly converted (63 DE) syrups of good colour and taste, widely used in marshmallows, preserves and beer fermentation.

Finally, the specific action of α-amylases on very low DE, acid-hydrolysed substrates allowed the production of soluble, non-retrograding, low-DE glucose syrups. These found use in the production of vending powers, baby foods and coffee whiteners.

2.2.2 *Total enzyme conversion*

The ability to degrade starch solely by enzyme action came in the mid-1970s with the advent of highly thermostable, bacterial α-amylases. By specifically hydrolysing 1–4 linkages at temperatures well above the gelatinisation temperature of starch, these calcium metalloproteins could supply non-retrograding intermediates of less than 10 DE. An extended and invaluable range of spray-dried products, widely used in the food and confectionery industries, thus became available (see Table 2.3).

These same, non-retrograding intermediates allowed a more flexible and greater control of the composition of subsequent glucose syrups (see Table 2.4) than did the prior, acid-hydrolysed materials. Improved 42 DE maltose syrups, containing less dextrose, more maltose and a tailored, higher sugars fraction could be produced using appropriate maltogenic enzymes. These have led to significant improvements in confectionery, particularly in high-boiled products, where better control of the rheology of the sugar mass has resulted in the ability to use higher sugar replacement levels, and better texture, better shelf life and lower colour formation are obtained.

Co-incubation with starch debranching enzymes, such as pullunase or iso-amylase enabled levels of maltose in excess of 75% to be attained. These

Table 2.3 Saccharide spectra of spray-dried maltodextrins and glucose powders

	DE							
	8–10	11–14	15–17	18–20	20–23	26–30	33–35	36–38
DP_1	0.3	0.5	1.0	1.0	1.5	1.5	1.5	1.5
DP_2	3.0	3.5	5.0	6.5	7.0	13.0	27.0	35.0
DP_3	4.5	6.0	10.0	11.0	11.0	21.5	21.0	21.0
DP_4	3.7	5.0	7.0	7.4	7.1	12.4	10.4	10.6
DP_5	3.5	4.9	6.2	6.3	7.6	8.6	3.4	2.1
DP_6	6.4	9.7	11.8	12.6	15.5	6.4	2.9	1.3
DP_7	9.0	10.7	11.0	11.4	13.5	3.0	2.2	1.3
DP_8						1.7	1.2	1.4
DP_9	2.6	3.0	2.1	2.1	1.4	1.6	1.1	2.7
DP_{10}	67.0	56.7	45.9	41.7	35.4	30.3	29.3	23.1

Table 2.4 Sugar composition of enzyme-converted glucose syrups

	DE		
Glucose syrup	42	53	65
Dextrose	2.5	2.0	34.0
Maltose	56.0	75.0	47.0
Maltotriose	16.0	14.0	3.0
Maltotetraose	0.7	0.5	2.0
Maltopentaose	0.4	0.4	1.5
Maltohexaose	0.7	0.6	1.0
Higher sugars	23.7	7.4	11.5

products have found use in the brewing industry and in the production of crystalline maltose.

Sweeter products in the 60–70 DE range, produced by all-enzyme routes, have well-controlled, diverse sugar compositions, promoting their use in proprietary medicines, beer and processed foods, as well as in the confectionery industry.

Dextrose levels of more than 97% can be achieved in enzyme-enzyme hydrolysate, making it suitable for very specific fermentation applications and greatly enhancing crystal yield when dextrose monohydrate (or anhydrous dextrose) is produced. Dextrose can be used to make confectionery tablets giving a smooth, cooling sensation on the palate.

2.2.3 *Hydrogenated starch hydrolysates*

Sorbitol and maltitol can be produced by hydrogenation of dextrose hydrolysate or very high maltose syrups respectively. These polyols are used

increasingly in 'sugar-free' confectionery, either as hydrogenated syrups or as the crystalline products derived therefrom. Both are suitable for diabetic products, with maltitol in particular being claimed to have very low cariogenicity and reduced calorific value. Maltitol approaches sucrose in sweetness.

2.2.4 *Fructose*

The most significant advance brought about in the starch industry by enzymes involves the actual isomerisation of the monomeric unit whereby fructose can be produced from starch. With the discovery of an enzyme, an isomerase, which could isomerise glucose to a 42% fructose-containing equilibrium mixture having a sweetness level equivalent to sucrose, a new generation of products was born. These had obvious potential in the soft drinks area, and today many products in the USA contain high-fructose corn syrup (HFCS). In Europe the product is not so widely used due to the imposition of a production quota by the EC.

Further chromatographic separation has allowed higher levels of fructose to be realised, and syrups containing 55% fructose are now used as soft drinks in the USA. Ninety percent fructose syrups have been produced in this way and have subsequently been crystallised to allow crystalline fructose to be produced. This material has been used in diabetic products in certain European countries where it is permitted for that use and in dietetic products. The rationale here is that the high sweetness of fructose, up to 1.8 times the sweetness of sucrose, allows less to be used in a product to achieve the same sweetness.

Partially isomerised 60–70 DE glucoses and their blends with HFCS, as well as HFCS itself (see Table 2.5), are finding limited application in the confectionery industry where invert sugar was possibly previously used. They offer greater versatility in fructose and sweetness levels together with alternative functional properties. Products of less than 10% fructose circumvent the EC quota system, although only a modest increase in sweetness is obtained.

So far we have considered the method of converting the starch into the hydrolysates which are required to produce the basic chemical composition of the glucose syrups. These are summarised in Figure 2.1. There are, however,

Table 2.5 Typical sugar composition of fructose syrups

	High	Intermediate	Low
Fructose	42.0	20.0	9.0
Dextrose	54.0	39.0	36.0
Maltose	2.4	30.0	36.0
Maltotriose	0.8	2.0	3.0
Higher sugars	0.8	9.0	16.0

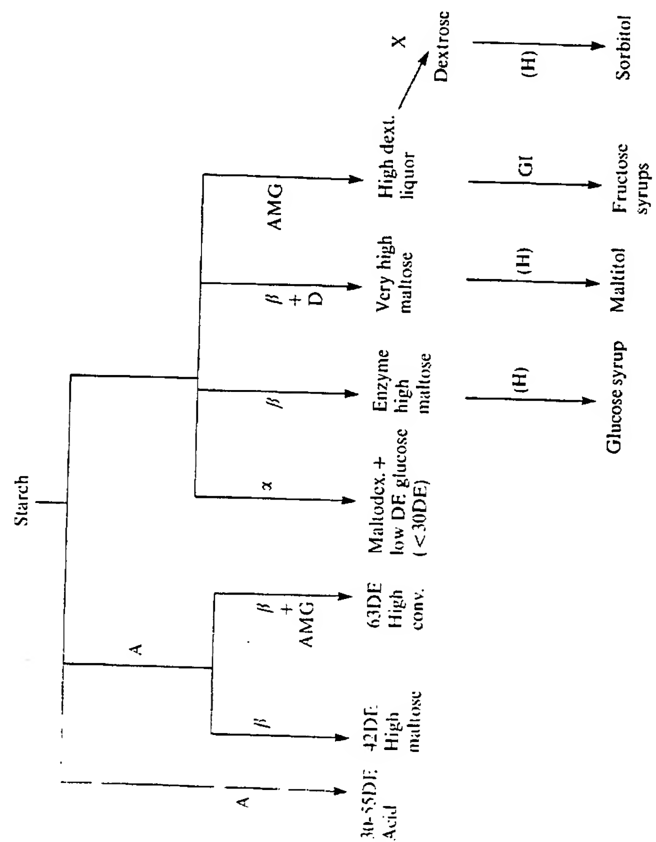


Figure 2.1 Starch products for the confectionery industry excluding blended products. Key: A, acid conversion; α, α-amylase; β, β-amylase; AMG, amyloglucosidase; (H), hydrogenation; X, crystallisation; GI, glucose isomerase; D, debranching enzyme.

other aspects of the manufacture of glucose syrup which have important implications for the user.

2.3 Refined glucose syrups

2.3.1 *Refining glucose syrups*

After the conversion of the starch by either acid or enzyme conversion, a detailed process of purification or refining takes place followed by evaporation in order to produce the water white viscous liquid which is so familiar to all confectioners. Initially the conversion takes place at 30–40% concentration, and the sugar solution has to be clarified to remove the protein and lipid fractions which have been liberated from the starch granule during conversion. In a maize-derived syrup this lipid/protein fraction or 'mud' as it is called comprises 0.8% of the solids. In wheat this will be slightly higher, whilst if potato is the base starch, the fat/protein content will be very low. The phosphate level of potato is the major impurity at this stage. Mud is removed either by rotary vacuum filtration or by centrifugation followed by in-place filtration, and the material passing this filter is clear and ready for further processing. The pH of this stage is critical, and the process works best at the isoelectric pH of the protein—usually in the region of 4.5.

The final stage of refining is the area where the trace organic impurities, furan derivatives, protein hydrolysates, etc. are removed. Traditionally this was done by using activated carbon. The carbon was either granular, in towers or columns which could be regenerated by heating in furnaces, or powdered, used only once in filter beds.

Advantages of powdered carbon are that less contamination occurs between different grades of glucose produced sequentially, that it is an excellent filter and that a blend of chemically or steam activated carbons can be chosen to give optimum colour removal and heat colour stability for each glucose type.

In more recent developments, however, ion-exchange resins are used to remove almost all of the organic and inorganic impurities in glucose syrups, providing products which are superior to carbon-refined glucoses in many respects.

2.3.2 *Resin-refined glucose syrups*

One of the major benefits accruing from resin-refining stems from the fact that colour-forming bodies are predominantly ionic in nature and are therefore very efficiently removed. Figure 2.2, drawn from data produced in the laboratories of Cerestar (UK) Ltd., show the greatly improved colour removal and colour stability thus obtained. The use of sulphur dioxide as an anti-browning agent can be virtually eliminated without loss of colour

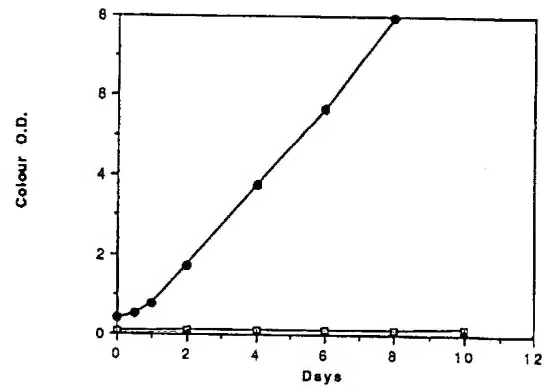


Figure 2.2 Heat colour stability of glucose syrups at 60°C. □, Resin-refined; ●, carbon-refined.

performance, though its addition still further enhances colour stability as shown in Figure 2.3.

Unlike carbon, resins also remove almost all of the inorganic ions in glucose syrups and this brings further benefits to the confectioner. Ash content is reduced from the 0.2–0.6% levels typically found in the carbon-refined, enzyme-enzyme and acid glucoses respectively, to 0.02% and below. This eliminates the possibility of haze due to insoluble sulphate or phosphates of calcium, since these ions are effectively absent. Chloride ions are also reduced

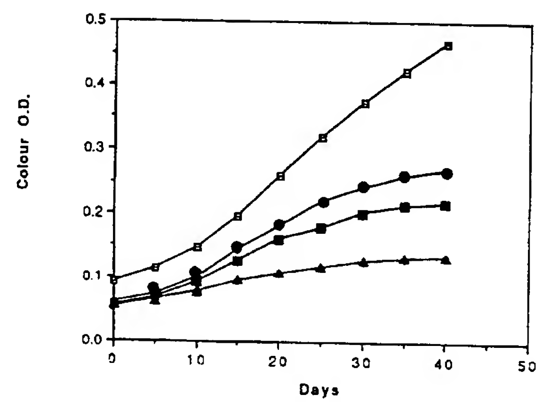


Figure 2.3 Effect of sulphur dioxide level on heat colour stability of resin-refined glucose syrups at 60°C. □, Neutral; ●, 50 ppm SO_2; ■, 100 ppm SO_2; ▲, 400 ppm SO_2.

by a factor of 10–100, this significantly decreasing the risk of corrosion to unlined vessels or plant constructed from lower grades of stainless steel.

Inorganic ions are sometimes used beneficially by the confectioner, who may, for example, add calcium to control the set of low-methoxyl pectin systems. In the near absence of ions in resin-refined glucoses, the precise amounts required can be added, with no necessity to compensate for the variable levels found in carbon-refined syrups.

Off-flavour and odour-producing contaminants in glucose syrups are also removed by resins, although carbon or polishing systems are required to remove taints picked up from resins themselves. The absence of inorganic salts improves organoleptic properties in that the more neutral, salt-free flavour allows increased perception of sweetness and is more compatible with flavouring additives.

A final factor to be taken into account with resin-refined glucose concerns pH. The virtual absence of both organic and inorganic contaminants greatly reduces buffering power, so that extremely small additions of acids or bases produce large pH changes. Where this gives a problem with pH control, the addition of very small quantities of buffer salts provides a solution. These effects are shown in Figure 2.4, where a comparison is made between carbon-refined, resin-refined and buffered, resin-refined glucoses, the buffer being only 250 ppm citrate on dry basis.

On storage above 50°C without buffer, the pH of resin-refined glucose falls rapidly to about 4, probably due to the formation of trace quantities of organic acids by oxidation. Although buffers prevent this fall, their addition

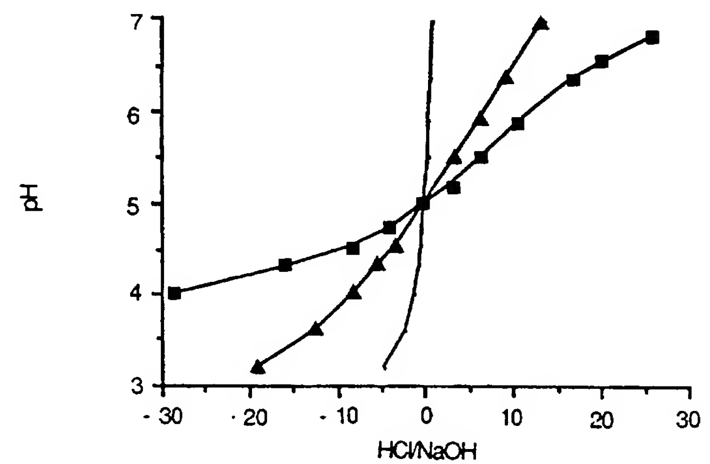


Figure 2.4 Glucose neutralisation curves. . Demineralised; ▲, demineralised/buffered; ■, carbon-refined.

is generally unnecessary and indeed counter productive. This very sensitivity to trace quantities of acids and bases ensures that the pH of the glucose has almost no effect on the pH of the candy system, while colour stability on storage is improved at the lower pH. Great care must be taken in formulation when using unbuffered glucose, however, since injudicious acid addition, for example, may give a surprisingly low pH.

Thus, it can be seen that the dramatic advances in glucose syrup composition which the introduction of enzymes has brought, and which were referred to earlier in this chapter, have heralded a new era in which the refining and colour stability of glucose syrups have been raised to a level where a new standard of performance and consistency is available to the confectionery industry.

2.4 Glucose syrups in sugar confectionery manufacture

2.4.1 *The fundamentals of sugar confectionery*

Why is a glucose syrup necessary in the manufacture of sugar confectionery? Could sucrose not be used by itself? To find the answer to these questions, consider the various properties a confection should have. These are:

(1) The confection must not undergo fermentation, mould growth or other microbiological spoilage during a long storage life.
(2) The confection must not undergo any change in its physical properties during this storage.
(3) It must have the desirable physical properties normally associated with the particular confection, e.g. it must not be too hard to eat comfortably, its texture and solubility must be pleasing to the palate and, not least, it must be flavoured correctly and be sweet-tasting.
(4) It must be pleasing to the eye. This factor is determined by the art and skill of the confectioner.

2.4.1.1 *The confection must not undergo any form of microbiological spoilage.* Whilst there is no completely clear-cut line, experience indicates that if the solids content is below 75% w/w certain moulds and yeasts will grow in carbohydrate solutions and spoilage will result. If, on the other hand, the solids content is below 75% w/w, then this is unlikely to occur. It must be remembered here that when considering sugar confectionery we are not dealing with a material kept under *commercially sterile* conditions, as with canned foods for instance, but with a product which must keep under normal, non-sterile conditions. The confection must be self-preserving in its own right since every source of confection cannot be kept away from it.

The saturation solubility of sucrose in water at 20°C is only 67.1% w/w. Thus sucrose alone cannot give us a product with a solids content sufficiently high to prevent microbiological spoilage. What can be done to alter this, and to permit us to prepare a solution stable against crystallisation with a solids content of 75% w/w or over at normal temperatures, i.e. 20°C? The answer is to have present in the solution with sucrose a sugar other than sucrose, a process known as 'doctoring'.

2.4.1.2 *The confection must not undergo any changes in its physical properties.* The main change in physical properties to be considered is the appearance of undesired crystals, which is called 'graining'. This crystal formation in sugar confections which should be free of any crystals is normally due to the formation in the confection of crystals of *sucrose* during storage. Such crystals spoil the appearance of the product and, in addition, cause an unpleasant roughness on the tongue.

In the case of high-boiled sweets, it is obviously impossible (using the traditional proportions of sucrose and glucose syrup) to obtain a product of 97% w/w solids content which is not supersaturated with respect to sucrose. However, it is well known that in practice using, for instance, 1.5 parts of sucrose to 1 part of 43° Be glucose syrup a high-boiled sweet can be prepared which can be stored for several years without any 'graining' taking place.

This is possible because high-boiled sweets are an example of what physicists call 'the glassy state'. Although they appear solid, they are in fact supercooled, non-crystalline liquids, liquids which are so far below their melting or softening point that they have assumed solid properties without crystallising. As such, they can be considered as liquids of enormously high viscosity, and high viscosity interferes very considerably with the process of crystal formation.

Consider what happens when a crystal forms. First, there must be a 'nucleus', that is a completely submicroscopic crystal to act as a starting point for the crystal to form. These 'nuclei' are formed spontaneously if the supersaturation is sufficient, but the higher the viscosity the lower the rate at which they form. The molecules of the substance crystallising have to 'hit' and 'stick' to the nucleus, being brought to it by the continuous, very rapid movement of the molecules in all liquids and solutions. But this movement is very severely limited in a solid or in a liquid of extremely high viscosity.

It is thus the extremely high viscosity and what one can call the pseudo-solid state of high-boiled sweets which in fact inhibits 'graining', i.e. the crystallisation of sucrose, during storage. However, even if the supersaturation *is* high, 'graining' can still take place, and this will happen if the 'doctoring' is too low.

Of course, when the boiling has been poured on the slab, and whilst it is being manipulated, its temperature is quite high, and quite clearly it is a very thick liquid and not a solid at all. Its viscosity in these stages, whilst high, is not nearly so high as when the final sweets have cooled to room temperature

and solidified. In fact, during the cooling period on the slab and the later manipulation an insufficiently 'doctored' boiling will most definitely 'grain'.

The stability of a confection and in particular a high-boiled sweet is therefore due to the sugars present being in a glassy state. This state is metastable, and once crystallisation has started, 'graining' is progressive. A change in the choice of raw material and the ratio of sugars in the recipe can affect the stability and the rate of 'graining'.

When confections are held in a humid atmosphere they will immediately begin to absorb water. This is present as a film of water around the surface of the product, which rapidly dilutes the non-crystalline mixture of carbohydrates. Crystallisation then commences, promoted by the lowered viscosity of the syrup film.

The solubility of carbohydrates increases as the temperature rises. Thus, the higher temperatures experienced during a boiling process at atmospheric pressure mean that the supersaturation with respect to sucrose is less than at the lower temperatures experienced during a vacuum boiling process. This explains why a higher proportion of 'doctor' must be used with a vacuum boiling process than is used with an atmospheric pressure process. If this higher proportion of 'doctor' is not used in a vacuum process, then 'graining' during processing is always a danger.

In the case of toffees, the solids content (eliminating the fat from our calculations) is usually about 90% w/w. Therefore, the situation here is rather different from that in the case of high-boiled sweets, where the solids content is of the order of 97–98% w/w. This lower solids content in toffees means that the viscosity of the sugary mass is very much lower. Thus, toffees lack the antigraining effects of the very high viscosity of high-boiled sweets, and must be more highly 'doctored'. For this reason, a ratio of sucrose to 'doctor sugar solids' of 1.24/1, or even in some cases 1/1, is used.

However, in spite of this heavy 'doctoring', toffees usually do have an appreciably shorter storage life before 'graining' sets in than is the case with high-boiled sweets.

2.4.1.3 *The confection must have the correct physical form.* High-boiled sweets, toffees and marshmallows are examples where 'graining' is detrimental to the appearance of the sugar confection. There are, however, certain confections which must have some 'grain' for them to have their traditional form, i.e. fudges and 'fondant'.

In the manufacture of 'fondant', a greatly underdoctored mixture is boiled to a comparatively low temperature, cooled and then beaten to start off the crystallisation of sucrose; the degree of doctoring, the temperature and the mechanical action ensure that a multitude of very fine sucrose crystals are formed. It is on the success of the production of a very large number of very small sucrose crystals that the smoothness of the fondant depends.

Fondant is of course a confection in its own right, but it is also used to promote crystallisation in fudges. The principle of the manufacture of a fudge is that a boiling is cooled to a temperature found by experiment to give the correct degree of supersaturation, and then very fine sucrose crystals in the form of fondant are added to 'start off' the crystallisation process. Obviously, here, details of manufacture and also the correct degree of 'doctoring' are matters of great importance. 'Pulled' sweets are another example of mechanical action being used to produce very fine sucrose crystals, in this case in much smaller numbers than in the case of fondant. Here the amount of doctor is, of course, much higher than in the case of fondant, and also the viscosity is much higher owing to the much higher solids content, both factors combining to reduce the number of sucrose crystals formed.

2.4.1.4 *The confection must be pleasing to the eye and the palate.* This really involves the art of the sugar confectioner. However, one aspect of taste which a glucose syrup can influence is sweetness, and this can be controlled to a degree by the type of syrup selected.

Since all the sugars produced by the hydrolysis of starch are reducing sugars, a measure of the total reducing power is also a measure of the degree of hydrolysis of the starch. Thus the dextrose equivalent (DE), defined as the total reducing power of the glucose syrup expressed on a dry solids basis as dextrose, is a measure of the degree of hydrolysis.

Thus as the DE increases the mean molecular weight decreases, the quantity of lower sugars, dextrose and maltose increases and the physical properties of the glucose syrup are influenced, as can be seen in Table 2.6. The major factors that are of interest to the confectioner are expressed in Table 2.7.

2.4.2 *Sweetness*

The sweetness of glucose syrup if tested in dilute solution is somewhat lower than sucrose at the same concentration. Figure 2.5 shows figures produced for aqueous solutions of glucose syrup by Nieman.[2] It can be seen from these figures how the relative sweetness of glucose syrup increases with concentration and how it increases with dextrose equivalent. Sucrose on this scale has the nominal value of 100. These figures for aqueous solutions of glucose syrup alone do not show the interesting synergistic effect which occurs in glucose/sucrose mixtures. As a result of this effect the sweetness of the mixture is greater than the sweetness calculated from Nieman's figures.

An example of this is that a mixture of 50% of 42 DE syrup and 50% sucrose can have a sweetness in excess of 75% at 50% solids.

These figures of sweetness should only serve as a guide because the real perception of sweetness depends upon a number of other factors, e.g. rate of solution, concentration of food on the palate, etc.

Table 2.14

	Glucose syrup type		
	DE 42 Acid-converted	DE 42 Acid enzyme	DE 42 Enzyme enzyme
Dextrose	15	6.0	3.5
Maltose	12	39.0	55.0
Polysaccharide	73	55.0	41.5
Sucrose/glucose syrup	100/80	100/100	100/180
Total reducing sugars (including 2% process inversion)	17.6	19.4	25.2
Monoreducing	6.9	3.7	2.8
Disaccharide/sucrose + maltose	63.3	70.6	71.4
Higher sugars (%)	27.9	24.1	24.1

glucose/sucrose formulations to be made while preserving the following characteristics:

Low processing viscosity.
Low dextrose, and so low hygroscopicity and good shelf life.
Low colour formation obtained by low dextrose and demineralisation.
Good textural properties.
Better heat conductivity.

This new range of products enables, for example, high solids depositing and the processing and manufacture of confectionery products at their final moisture content, without the requirement for the use of post-drying operations. Continuous processes and flow lines can be created without breaks and bottlenecks, which are usually created due to a drying stage in the manufacture.

The manufacturer can improve the consistency of his products and produce at higher efficiencies and lower costs. The ingredients and their selection sometimes require considerable change from normal when changing an existing product line to continuous production. The overall objective in formulation change is to maintain the best of the qualities of the existing product so that it can be eaten without the consumer noticing any obvious changes. The wide variety of properties, constantly being improved by modern technology, ensures that its use is limited only by the ingenuity of the confectioner.

References

1. D. Howling, in *Sugar: Science and Technology*, eds. G.G. Birch and K.J. Parker, Applied Science, London (1979) 259.
2. Nieman, *Ned. Chem. Ind.* **2** (1960) 257.
3. Money and Born, *J. Sci. Food Agric.* **2** (1951) 180.

Further reading

H.E. Horn, *Corn sweeteners: functional properties. Cereal Food World* **26** (1990) 219.
D. Howling *et al.*, in *Glucose Syrups: Science and Technology*, eds. S.Z. Dziedzic and M.W. Kearsley, Elsevier Applied Science, London & New York (1984).
R. Lees and B. Jackson, *Sugar Confectionery and Chocolate Manufacture*. Leonard Hill, Glasgow (1973).
H.M. Pancoast and W.R. Junk, *Handbook of Sugars*, 2nd edn, Avi-Publishing, New York.

Table 7.3 Sugar composition of acid converted glucose syrup

Glucose syrup sugars composition	Dextrose equivalent 30	34–36	42–43	55
Dextrose	10	13.5	19	31
Maltose	9	11.5	14	18
Maltotriose	10	10	12	13
Maltotetrose	8	9	10	10
Maltopentose	7	8	8	7
Maltohexose	6	6	7	5
Maltoheptaose	5	5.5	5	4
Higher sugars	45	36.5	25	12
Mean mol. weight	650	580	450	345
Viscosity (poise) (81% d.s. at 37.8°C)	230	200	150	100

Table 7.4 Sugar composition of acid/enzyme converted syrups

Glucose syrup sugars composition	Type of high maltose 42	48	High conversions (amyloglucosides) 63	70
Dextrose	8	9	37	43
Maltose	45	52	32	30
Maltotriose	12	15	11	7
Maltotetrose	3	2	4	5
Maltopentose	2	2	4	3
Maltohexose	2	2	3	2
Higher sugars	30	18	9	10

depositing high-boiled base by reducing the 'tails' formed. In this process, after the depositing pump stroke completion, the moulds move forward a stage. A tail can trail from the pump exit pipe to the mould cavity in which the sweet has been deposited. Using high maltose syrups can thin the cooked base sufficiently so that the tail breaks easily, early and drops directly onto the surface of the deposited sweet and melts in. It is important not to have tails protruding from the sweet since the sharpness of the drawn out point could possibly damage consumers' oral cavities. Reduced viscosity cooked sugar mass has various advantages. Less air is entrapped during kneading in batch processing and increases clarity, whilst reducing haziness and opacity inherent in the processing (Figures 7.1 and 7.2). The product colour is less yellowish, closer to water white and a brighter product appearance is seen. This is partly due to the low level of dextrose in the product reducing hygroscopicity and helping reduce surface graining during the shelf life of formed products. The lower viscosity is achieved because there are much lower concentrations of oligo and polysaccharides formed by the enzyme conversion than is the case for acid conversion glucose. Good quality glucose

Table 5.8. Approximate Composition (%) of Products That Provide MSNF for Ice Cream

Product	Water	Fat	Protein	Lactose	Sucrose	Ash
Evaporated milk	73.00	8.30	7.50	9.70		1.40
Plain condensed milk	70.00	8.50	7.80	11.90		1.80
Skim milk	90.5	0.1	3.60	5.10		0.70
Condensed skim milk	71.00	0.50	8.80	12.70		2.00
Sweetened condensed whole milk	27.47	9.28	7.42	13.35	40.60	1.88
Sweetened condensed skim milk	29.00	0.06	10.32	15.60	42.27	2.25
Condensed buttermilk	72.00	1.95	10.61	13.01		3.33
Condensed whey	48.10	2.40	7.00	38.50		4.00
Sweetened condensed whey	28.50	1.70	5.00	28.50	38.00	2.80
Dried whole milk	2.00	27.00	26.50	38.00		6.05
Nonfat dry milk	3.23	0.88	36.89	50.52		8.15
Dry buttermilk	3.90	4.68	35.88	47.84		7.80
Dry whey	6.10	0.90	12.50	72.25		8.90
Dried malted milk	3.29	7.55	13.19	72.40[a]		3.66
Whey	93.2	0.30	0.90	5.10		0.50
Sodium caseinate	4.0	1.50	94.00			4.00

[a]Lactose, maltose, dextrin.

properties, resistance to heat shock, and the flavor, body, texture, and appearance of the finished products.

Table 5.8 gives the approximate composition of the main sources of MSNF in ice cream.

The relationship between salt balance and stability to heat coagulation of the milk components has long been realized. The importance of the effects of the mineral salts has been recognized in the acceptance of the mineral salts as optional ingredients in the frozen-dessert standards and specifications. The mineral salts recognized as optional ingredients for frozen desserts are listed in Table 5.1. A review of the effects of the various salts is given in Chapter 4.

Calcium sulfate is included as an optional ingredient and is typical of specific effects salts may produce. Calcium sulfate's rate of use is 0.08–0.16%, and should be added to the mix before the pasteurization process. The use of calcium sulfate increases the acidity of the mix, produces a dry, stiff ice cream from the freezer, and reduces the rate of melting but has little effect on other properties of the mix or finished ice cream, which may be influenced by the kind of stabilizer used.

SOURCES OF SWEETENER SOLIDS

Many kinds of sweeteners are used in ice cream (see Table 5.9). They include cane and beet sugar, corn sweeteners, maple sugar, honey, invert sugar, fructose, molasses, malt syrup, brown sugar, lactose, and refiners syrup.

From 25 to 50% or more of cane or beet sugar may be replaced by corn sugar with good results. The use of a combination or blend of sugars in either dry or

liquid form is a popular practice—such blends are usually 70% sucrose and 30% corn sweetener. The desired sugar concentration in ice cream is 15–16% on a sucrose basis. The different kinds of sugar do not produce equal sweetening effects although sweetness can neither be exactly defined nor measured. Leighton (1942) stated that the zone of satisfactory sweetness in ice cream was 13–16% sugar content, and that sweetness in ice cream is dependent upon the concentration of sugar in the water of the mix and that decreasing the water in the mix is equivalent to increasing sweetness. He further stated that sugars are important as an ingredient in ice cream other than for their sweetness because of the physical properties of the sugars and their effect upon the freezing point of the mix. In addition, they depress the freezing point of the mix, produce a thinner mix with a slower whipping rate, and produce an ice cream with a smoother body and texture with faster melting qualities. Sugar blends may be expected to affect mix and finished product qualities in accordance with the proportion of the kind of sugars in the blend.

Relative Sweetness

Dahlberg and Penczek (1941) studied the relative sweetness of sugars, the effects of one sugar on another, their concentration, and temperature. Since there is no chemical test for sweetness there is not complete agreement on the relative sweetness value of the various sweeteners. An approximate relative sweetening value of sugars and other substances (using sucrose as a basis with a value of 100) is given in Table 5.10.

Effect on Freezing Point

Sugars do not dissociate in solution and the freezing point of their solution can be computed by the known concentration of the solution and the molecular weight (see Fig. 5.2). With given weights and volumes of solvent, the effect on the freezing point will be inversely proportional to the molecular weight, i.e., the higher molecular weights will cause the least lowering of freezing point, while the sugars with the low molecular weights will cause the greatest lowering of freezing point. The molecular weights of some sweetener solids are given in Table 5.11.

Tharp (1982) gave formulas for calculating the freezing point based on the differences in molecular weight of carbohydrates and other dissolved material. He stated that the freezing of any multicomponent system (such as a frozen-dessert mix) is somewhat more complex than the simplicity of the calculations may suggest.

For the years 1950, 1960, 1972, 1975, 1980, and 1981, Tharp gave the following data for the freezing point of ice cream (based on typical mix compositions): 27.70, 27.00, 27.17, 27.07, 26.47, and 25.77°F, respectively. It appears that changes in the amount of sweetener solids included in the mix formulation were mainly responsible for the freezing-point variation.

Table 5.9. Sources of Sweetening Agents in Ice Cream

Product	Physical appearance	Type of sugar	Sugar (%)	Amount equal to 1 lb sucrose (lb)	Maximum total sugar supplied (%)	TS (%)	Weight per gallon (lb)
Sugar							
granulated sugar	Dry crystals	Sucrose	100	1.00	100	100	7.5
dextrose	Dry crystals	Glucose	80	1.25	35	92	—
Dried corn syrup solids	Dry crystals	Dextrose, maltose	47	2.10	35	96.5	—
Liquid sugar	Liquid	Sucrose	67	1.50	100	67.0	11.1
(80–20 blend)[a]	Liquid	Sucrose, dextrose	68	1.58	100	68.0	11.2
Sucrose·67 Brix, corn syrup 42 DE	Liquid	Dextrose, maltose	67	1.50	35	83.0	9.5
Corn syrup[b]							
low-conversion, 36 DE	Liquid	Dextrose, maltose	52	1.90	25–50	80	11.8
regular-conversion, 42 DE	Liquid	Dextrose, maltose	60	1.66	25–50	80.0	11.8
intermediate-conversion, 52 DE	Liquid	Dextrose, maltose	68	1.47	25–50	81.0	11.8
high-conversion, 62 DE	Liquid	Dextrose, maltose	80	1.25	25–50	81.0	11.8
High maltose		Maltose, dextrose	63	2.00	25–50	80.0	11.8
Invert sugar syrup[c]	Liquid	Dextrose, levulose	95	1.05	33	74	11.5
Honey[e]	Liquid	Dextrose, levulose, sucrose	75	1.40	30[d]	—	—
High fructose							
42	Liquid	Dextrose, fructose	71	1.40	25–30	71	11.23
55	Liquid	Dextrose, fructose	77	1.30	50	77	11.55
90	Liquid	Dextrose, fructose	80	0.70	50–100[f]	80	11.74
55 and 36 DE (1–1)	Liquid	Dextrose, fructose	78	1.30	78–100[g]	78	11.77

[a]The usual liquid sugar (67%) employed by ice cream makers.
[b]The usual commercial syrup of 43° Baumé.
[c]Assuming 95% complete inversion with a 74% sucrose solution.
[d]Assuming a mild-flavored honey, less if strong flavored.
[e]Higher percentage may lower freezing point.
[f]Low-calorie frozen dessert.
[g]Economy brand.

Note: Approximate data to serve as a guide for calculating mixes. DE stands for dextrose equivalent, which is a measure of reducing-sugar content calculated as dextrose and expressed as a percentage of the total dry substance. For pure dextrose, DE = 100. Corn syrups and corn syrup solids are available in the DE range 28–62.

Table 5.10. Relative Sweetness of Ice Cream Ingredients[a]

Fructose	173
Invert sugar (glucose and fructose)	127
Sucrose	100
Glucose (dextrose)	74
Corn syrup	
high-conversion (62 DE)	68
medium-conversion (52 DE)	58
low-conversion (42 DE)	50
low-conversion (32 DE)	42
Xylose (wood sugar)	40
Galactose	32
Maltose	32
Rhamnose	32
Lactose	16
Saccharin	200–700
Dulcin	70–250
Hexahydric alcohol	50
Sucaryl	30–50

[a]Sucrose as basis, 100.

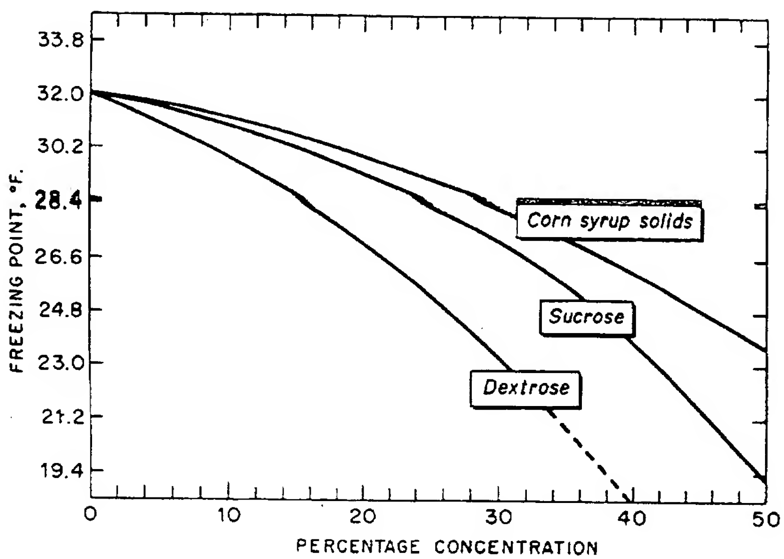


Fig. 5.2. Freezing point variation with differing sugar concentrations. Courtesy of American Maize Products Co.

Table. 5.11. Approximate Molecular Weights of Sweetener Solids

Sucrose	342
Lactose	342
Maltose	342
Dextrose	180
Fructose	180
Fructose-90	182
Fructose-55	185
Fructose-42	190
Corn syrup	
enzyme-converted	258
62 DE	298
52 DE	360
42 DE	428
36 DE	472
32 DE	540
28 DE	568

Sucrose

Sucrose, commonly known as granulated sugar, comes from cane sugar and beet sugar and is the most widely accepted source of sugar. Cane sugar contains approximately 99.9% TS. It is highly soluble and has a specific gravity of 1.595. Although sucrose depresses the freezing point, its concentration in ice cream is limited only by its sweetening effect (see Fig. 5.2). It has been found that a 2% increase in sucrose content of a mix lowers the freezing point approximately 0.4°F. Sucrose may be used as the sole source of added sweetener solids in ice cream with excellent results. It is not satisfactory as the only source of sugar in ices and sherbets since it may crystallize out at the surface. This defect in ices and sherbets can be avoided by using 1 part of dextrose to 3.5 parts of sucrose. Sucrose is a disaccharide, and when hydrolyzed a molecule of sucrose combines with a molecule of water and breaks down into glucose and fructose (levulose). This sugar may be used in a dry or liquid form (liquid sugar contains approximately 67% sucrose).

Corn Sweeteners

Corn sweeteners of three major types are available for use in ice cream: refined corn sugar (dextrose), a dry crystalline product; dried corn syrup (or corn syrup solids); and liquid corn syrup. The use of corn syrup solids in ice cream has been reported by Corbett and Tracy (1939), Corn Industries Research Foundation (1958), Drusendahl (1963), Nieman (1960), Tharp (1961), Trempel (1962), Tracy and Edman (1940), and Wolfmeyer (1963).

Corn syrup solids or corn syrup impart a firmer and heavier body to the finished ice cream, provide an economical source of solids, and improve the shelf life of the finished products. The sweetness comes from dextrose, i.e., D-glucose. Commercially, the term glucose is incorrectly applied to a variety of

syrup solids is used with sucrose as a sweetening agent for ice cream because it is cheaper, improves body, texture, and flavor characteristics, and extends the shelf-life of the finished product.

Many good sugar blends are now available. There has been much interest in blends of the low-conversion corn syrup solids products, because they help increase solids and maintain product properties and sweetness. Similarly, blends of sucrose with medium- or high-conversion corn syrup solids have also been used advantageously. High-fructose corn syrups (42, 55, and 90%) have an important role as an ice cream sweetener.

The values sometimes used as a guide in estimating the freezing point depression for these products are given in Table 5.12.

Dextrose, or refined corn sugar, is a white crystalline or granular sugar obtained by the hydrolysis of corn starch. Dextrose is a monosaccharide, containing approximately 99.8% sugar solids. Mack (1927) recommended the use of dextrose in high-fat mixes for more desirable body, texture, and melting characteristics. Dextrose is now quite extensively used in ice cream and is considered necessary in sherbets and ices to inhibit the crystallization of sucrose on the surface. Since it is only about 80% as sweet as sucrose, 1.25 lb of dextrose is needed to obtain the sweetening effect of 1.0 lb of sucrose. Dextrose lowers the freezing point more than does sucrose because its molecular weight is lower. This effect on the freezing point limits the amount of dextrose that can be used to about 25% of the total desired sugar. Usually dextrose is more economical than sucrose as a source of sweetness. Dextrose has a slightly greater tendency than cane or beet sugar to become lumpy when exposed to or stored in slightly moist air.

Dried corn syrup solids are produced by dehydration of corn syrup and are available in two forms—a white powder and a coarser granular material. The

Table 5.12. Guide to Estimating the Freezing Point Depression of Various Sweeteners[a]

Sweetener	Sucrose equivalence value (SE)	Freezing point equivalence factor
Sucrose	100	1.00
Lactose	100	1.00
Maltose	100	1.00
Dextrose	180	0.55
Fructose	180	0.55
90%	187	0.53
55%	185	0.54
42%	180	0.55
62 DE	114	0.58
52 DE	95	1.05
42 DE	79	1.27
36 DE	72	1.39
32 DE	63	1.59
28 DE	58	1.67
Dextrin (C18–C40)	67	1.47

[a] The sucrose equivalence value is based on the molecular weight of sugar. The freezing point equivalence factor for freezing point depression of a sweetener is based on the molecular weight relative to that of sucrose. The percentage of the sweetener is multiplied by the appropriate freezing point equivalence factor to give the freezing

chemical composition of corn syrup solids is identical with that of the syrup from which they were made (see Table 5.13). They contain the sugars dextrose and maltose together with dextrine (prosugar), but usually contain no starch. They are white granular solids and about equal to cane sugar in their tendency to become lumpy when exposed to moist air. They usually have been more economical than cane sugar, but because of their lower sweetening effect it requires about 2.1 lb of Frodex or corn syrup solids to produce the sweetness obtained from 1.0 lb of sucrose. The dextrins they contain actually raise the freezing point slightly. These dextrins also increase the total solids of the mix and supply some stabilizing effect against coarseness. The effect on the freezing point and smoothness seems to give corn syrup solids an advantage over dextrose not only in sherbets and ices but also in ice creams of low TS concentration. Usually not more than 25–35% of the total sweetener is supplied by corn syrup solids.

Corn syrup, frequently incorrectly called "glucose," is made either by acid hydrolysis or by enzyme hydrolysis of corn starch. It contains no sucrose, but does contain a variable amount of dextrose and maltose with some impurities depending upon the degree of refining used in its manufacture. It may be considered as a source of dextrose. While its sugar content and also TS content vary considerably, it is usually safe to assume that 1.5 lb of corn syrup will replace 1.0 lb of sucrose. The effect on the freezing point is similar to that of corn syrup solids.

The four major types of corn syrups used in ice cream based on degree of conversion are (1) low-conversion, 28–38 DE; (2) regular-conversion, 38–48 DE; (3) intermediate-conversion, 48–58 DE; and (4) high-conversion 58–68 DE. The high-conversion syrups are further classified as acid conversion and acid enzyme syrups, depending on the method of manufacture.

Other Sweeteners

A maltose syrup containing approximately 45% maltose has been introduced for use in ice cream manufacture. It is bland in flavor and is sweeter than the lower-DE syrups.

Malt syrup may contain approximately 70% maltose. Dried maltose syrup, malt syrup, or malt extract, with properties similar to those imparted by maltose, may be used. Malt products carry a typical malt flavor and may impart it to ice cream depending on usage rates.

Maple and Brown Sugars

Maple sugar and brown sugar (which is raw or muscovado sugar obtained from the juice of sugar cane by evaporation and draining of molasses) contain characteristic flavoring materials, which limits their use in ice cream. For example, only 6% of maple sugar in the mix will produce a good maple flavor. Furthermore, these sugars are usually more expensive than other sources of sweeteners.

Table 5.13. Approximate Carbohydrate Composition of Corn Syrup and Corn Syrup Solids (Dry-Substance Basis)[a]

	Saccharides (%)							
	Mono-	Di-	Tri-	Tetra-	Penta-	Hexa-	Hepta-	Higher
Low (32 DE)	11.5	10.2	9.2	8.6	7.5	6.2	5.3	41.5
Regular (42 DE)	18.5	13.9	11.6	9.9	8.4	6.6	5.7	25.2
Intermediate 52 (DE)	27.5	17.2	13.1	9.9	7.7	5.7	4.7	14.2
High-conversion (62 DE) (acid or enzyme)	38.8	28.1	13.7	4.1	4.5	2.6	—	8.2[b]
High-fructose								
42 DE	94	—	—	—	—	—	—	6.0
55 DE	97	—	—	—	—	—	—	3.0
90 DE	99	—	—	—	—	—	—	1.0

[a]Courtesy, Corn Industries Research Foundation, Inc.
[b]Includes heptasaccharides.

has about 10% moisture, 86% sucrose, and 4% invert sugar; whereas maple syrup has about 45% moisture, 52% sucrose, and 3% invert sugar.

Honey

Honey is composed of about 74.5% invert sugar, 17.5% moisture, 2% sucrose, 2% dextrin, and 3.8% miscellaneous matter. It is used in ice cream principally to make honey-flavored ice cream, at the rate of 9 lb honey and 8 lb sucrose to produce the desired sweetness and flavor. Honey may not blend well with other flavoring, and the addition of other flavors to honey ice cream is not recommended. Tracy *et al.* (1930) found considerable variation in the color and composition of honey, depending on the source of the bees' food.

Fructose is a white crystalline powder (DL-1 levulose) produced in commercial quantities. It was approved as an ice cream sweetener in the 1970s. Its empirical formula is $C_6H_{12}O_6$, with a molecular weight of about 180. It seems to have potential as a sweetener in dietetic ice cream, because of the high relative sweetness value. Fructose gained stature as a safe and suitable ingredient in the mid-1970s. At that time its cost was $0.70–0.75/lb, but its production cost has dropped markedly since that time.

Saccharin, the first nonnutritive sweetener to be used commercially, is not a sugar, but a product derived from coal tar. It has a sweetening effect up to 550 times that of sucrose. However, its use has been drastically reduced because it has been linked to the occurrence of cancer in laboratory animals. The status of nonnutritive sweeteners has changed greatly within the past few years, since they have been in the group of dietetic or dietary frozen desserts. It is generally recognized that a dietetic or dietary frozen dessert is prepared from the same ingredients and in the same manner as ice cream, ice milk, or nonfrozen dairy desserts except that the optional sweetening ingredients are replaced entirely by a low-caloric or noncaloric sweetening agent.

SUGAR-SAVING SUGGESTIONS

In times of sugar shortage the following suggestions should be helpful to the ice cream manufacturer in stretching an allotment of cane and beet sugar:

1. Use more of other sources of sugar such as corn sugar and corn syrup solids. As already noted, these products can be used to replace as much as 25–35% of the sugar required in the formula. Many ice cream makers are coming to believe that a finer quality of ice cream is produced when part of the sucrose is replaced by corn syrup solids. Maple sugar, maple syrup, honey, and sorghum, when available and not too high priced, can also take the place of a limited amount of cane or beet sugar in the mix.

2. Reduce the sugar content in the ice cream by replacing part of it with milk solids. Research carried on by the USDA revealed the fact that sweetness of ice cream depends upon the concentration of sugar in the water of the mix. Therefore, if part of the free-water content of the mix is absorbed by the addition of milk solids, there will be less volume of water to dissolve the sugar.

and this higher concentration will taste sweeter. It was found that a saving of as much as 20% of sugar can be made without lowering the degree of sweetness of the ice cream.

3. Invert up to 35% of the cane or beet sugar required in the mix. Since invert sugar tastes sweeter, its use in time of sugar scarcity is recommended even though some additional labor and expense is involved in the inversion process.

Syrups

Sugars in the form of syrups may also be used. This form of sweetener is coming into general use as liquid sugar products, because of their favorable handling and price advantages. These products sometimes contain two or more sugars. Sucrose can be purchased as a liquid product containing 67% sucrose solids, and blends of sucrose with corn sweeteners are available in various combinations.

The TS concentration of sucrose syrups is usually measured by "degree Brix," which assumes all the solids to be sucrose. This is a safe assumption for practical purposes. Corn syrup, and many others, are often labeled with a Baumé reading. This reading is based on the specific gravity of the syrup and therefore is also a measure of the TS concentration.[3] However, it does not indicate the kind or amounts of the various sugars and dextrins present in the syrup. Baumé and Brix are not the same (see Table 5.14). Baumé readings must be converted into specific gravity terms before the TS concentration can be calculated (see Table 5.15).

Baumé readings and percentage total solids should not be called "sweetness" or "percent sweet" and should not be confused with the sweetening effect, which depends upon the kinds and concentration of sugar present.

Blended syrups are used in the manufacture of ice cream in many areas. A typical commercial blend is one containing 70% sucrose (66.5°Brix) and 30% corn syrup. This blend has approximately 70% solids.

Refiners' Syrup or Liquid Sugar

Refiners' Syrup and liquid sugar are trade designations for the colorless sucrose syrup used by ice cream manufacturers. As yet, deliveries of liquid sugar are made only in tank cars and tank trucks, and so its use has been restricted to ice cream manufacturers having facilities for this type of delivery.

Hydrolyzed Cereal Solids

Hydrolyzed cereal solids is a newer food grade ingredient that increases the solids but adds little sweetness or flavor and has little effect on the freezing

[3]Specific gravity is the ratio of the density of a liquid compared to the density of water at 39°. It is given by $145/(145 - d)$, where d is the Baumé hydrometer reading at 68°F.

Table 5.14. Relation of Baumé Reading to Brix Reading (Sucrose Syrup)

Degrees Baumé	Degrees Brix	Weight (lb/gal)	Sugar (lb/gal)	Water[a] (lb/gal)
33.0	61.0	10.78	6.58	4.20
33.5	62.0	10.83	6.71	4.12
34.0	63.0	10.88	6.85	4.03
34.5	63.9	10.92	6.98	3.94
35.0	64.9	10.97	7.12	3.85
35.5	65.9	11.02	7.26	3.76
36.0	66.9	11.07	7.41	3.66
36.5	67.9	11.13	7.56	3.57
37.0	68.9	11.18	7.70	3.48
37.5	68.9	11.23	7.85	3.38
38.0	70.9	11.28	8.00	3.28
38.5	71.9	11.33	8.15	3.18
39.0	72 9	11.39	8.30	3.09
39.5	73.9	11.44	8.45	2.99
40.0	74.9	11.49	8.61	2.88

[a]One U.S. gallon of water at 68°F. weighs 8.322 lb.

Table 5.15. Approximate Physical Constants of Corn Syrups

Baumé	Specific gravity	Solids (%)	Weight (lb/gal)	Solids (lb/gal)
Low-conversion corn syrup—32 DE				
42	1.4049	77.64	11.700	9.084
43	1.4184	79.59	11.813	9.402
44	1.4322	81.53	11.928	9.725
45	1.4463	83.51	12.045	10.059
46	1.4605	85.49	12.163	10.389
Regular-conversion corn syrup—42 DE				
42	1.4049	78.30	11.700	9.161
43	1.4184	80.27	11.813	9.482
44	1.4322	82.25	11.928	9.811
45	1.4463	84.25	12.045	10.148
46	1.4605	86.26	12.163	10.492
Intermediate-conversion corn syrup—52 DE				
42	1.4049	78.94	11.700	9.236
43	1.4184	80.94	11.813	9.561
44	1.4322	82.96	11.928	9.895
45	1.4463	84.98	12.045	10.236
46	1.4605	87.03	12.163	10.586
High-conversion corn syrup—62 DE				
42	1.4049	79.59	11.700	9.312
43	1.4184	81.62	11.813	9.642
44	1.4322	83.67	11.928	9.980
45	1.4463	85.72	12.045	10.325
46	1.4605	87.80	12.163	10.679

BEST AVAILABLE COPY

Operating instructions
FRESH UP Ice Bandit

Dear customer,

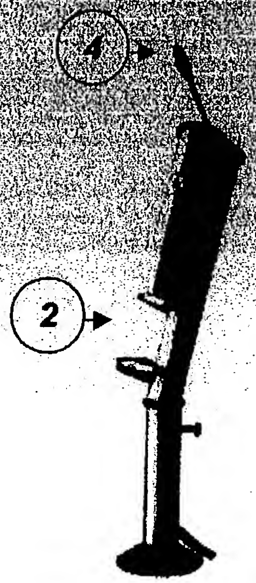
We are pleased that you have decided to purchase the Nestlé Fresh UP Ice Bandit system.

So as to make handling the device and the products easier for you, we provide you with information regarding the operation of the device and the use of our products below.

Prior to using the squeezing device, please check the temperature in the chest freezer (this is best done by means of an independent, hand-held measuring device) and adjust the setting if necessary. For model Liebherr GTE 2400 chest freezers, a setting between 3.8 and 4 needs to be selected (refer to the enclosed sheet).

Freshly delivered products, for example straight off a lorry or from a storage chest with temperatures below −18 °C first have to be made the right temperature until all of the products have reached a temperature of -18 °C. 8 – 12 hours are usually necessary for this process.

It is pointless to try to squeeze out cartridges that are too cold with a lot of effort.



Sequence of operation

1. Remove ice-cream cartridge from freezer.
2. Carefully pull off authenticity seal and put cartridge into pale holding ring.
3. Hold the comet in your hand and guide it underneath the holding ring or cartridge.
4. Simultaneously slowly pull down the lateral squeezing lever with your other hand, watching the comet crown developing until the cartridge is completely empty!
5. Hand the customer the filled ice-cream cone.

Enjoy it!

Caution:

Do not try to squeeze out the cartridge using force. If squeezing out is too difficult, you should check the temperature of your chest freezer and readjust it if necessary.

On no account may the squeezing lever be extended, there is danger of injury!

Only cartridges produced by Nestlé that have been developed for this system and temperature range may be used.

Please use a customary dishwashing liquid to clean the device. Clean the holding ring and the squeezing tube at least once a day.

On devices with vacuum base, the base of the device must be loosened and the device stored in a flat, i.e. safe, position, as the suction force of the base may decrease after max. 12 hours.

Appendix: Chest freezer setting Liebherr GTE 2400

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 147 483 A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 83113183.4

(22) Date of filing: 28.12.83

(51) Int. Cl.[4]: A 23 G 9/02
A 23 G 9/04

(43) Date of publication of application: 10.07.85 Bulletin 85/28

(84) Designated Contracting States: AT BE CH DE FR GB IT LI LU NL SE

(71) Applicant: THE PILLSBURY COMPANY
200 South 6th Street
Minneapolis Minnesota 55402(US)

(72) Inventor: Desai, Nitin
872 Raymond Apt. 10
St. Paul Minnesota 55114(US)

(72) Inventor: Delaney, Rory A.M.
16708 Picha Lane
Minnetonka Minnesota 55343(US)

(72) Inventor: Brouwer, Peter
28th Avenue North
Plymouth Minnesota 55441(US)

(72) Inventor: Huang, Victor T.
3813 72nd Avenue North
Brooklyn Center Minnesota 55429(US)

(74) Representative: Patentanwälte Grünecker, Dr. Kinkeldey, Dr. Stockmair, Dr. Schumann, Jakob, Dr. Bezold, Meister, Hilgers, Dr. Meyer-Plath
Maximilianstrasse 58
D-8000 München 22(DE)

(54) Stable aerated frozen food product.

(57) A process for preparing an aerated frozen food product such as mellorine or a shake beverage wherein water, fat, protein, emulsifier and stabilizer are blended together to form a mix which is homogenized to form an oil-in-water emulsion and is subsequently whipped under freezing conditions. Improved stability is achieved in the product by selecting a specific oil having high solid fat content at room temperature, homogenizing the mix of ingredients under conditions sufficient to form an emulsion having a relatively narrow distribution of small diameter fat globules, and aging the emulsion to crystallize the fat globules prior to whipping. Stable aerated frozen products provided in accordance with this invention can be stored and distributed at 0°F without loss of quality and have a variety of commercial uses.

EP 0 147 483 A1

STABLE AERATED FROZEN FOOD PRODUCT

Frozen aerated food products to which this invention is directed include frozen desserts such as ice cream, ice milk, mellorine, sherbet, frozen custard, frozen pudding and the like, frozen shake beverages such as milk shakes, and frozen shake concentrate. The popularity of these products is attributable to their convenience, widespread availability, nutritive value and appealing forms, colors and flavors. In part due to the familiarity of such frozen products to the consumer, to be acceptable they must not only have suitable flavor and appearance, but also possess a complex set of physical properties which provide the characteristics which consumers have come to expect. In addition, the nature and composition of the most popular aerated frozen products are set by various standards promulgated by the U.S. Food and Drug Administration as well as the individual states. Such rigid consumer acceptance criteria, regulatory standards and the complex nature of the interactions which produce a satisfactory product make it extremely difficult to reformulate such aerated frozen products in an attempt to provide improvements. Solutions to one set of problems quite often generate other problems which make the product unacceptable.

Stability is one major problem of conventional aerated frozen products. For example, ice cream and related aerated frozen desserts are stored, distributed, delivered and sold at deep freeze temperatures, i.e. -20°F, to give some measure of stability to these products and protect against deterioration of their special textural properties. This storage and distribution system, however, has many drawbacks both from the consumer's and manufacturer's point of view. One problem is that, at deep freeze temperatures, the product is so hard that it is difficult to scoop and serve immediately from the deep freeze.

Another major problem is that temperature fluctuations invariably occur during storage and handling of aerated frozen products which result in the thawing and refreezing of the product, seriously deteriorating its quality over time. This "heat shock" is characterized by the formation of large ice crystals, and results in excessive hardening and gritty mouthfeel. Heat shock frequently also produces a separation of the syrupy aqueous phase from the air and fat matrix which ultimately make the appearance and texture of the product unacceptable.

Several solutions to these problems have been attempted in the past. For example, increased stability has been imparted to aerated frozen desserts through the use of various stabilizers and stabilizer combinations. The drawback of this approach is that stabilizers frequently are required in such great quantities that the feel of the product in the mouth is altered, producing a cloying, gummy or greasy sensation. Another approach has been to increase the amount of added sugars relative to the fat and/or water in the product, but the large amount of sugar required to provide acceptable stability often

results in too sweet a taste or unacceptable crystal formation. Still another approach has been to increase the amount of incorporated air, i.e., "overrun", and thereby decrease the amount of freezable water per unit volume. This attempt at reformulation, however, not only results in a texture which is more characteristic of a whipped topping than of a frozen dessert like ice cream, but is limited by the applicable standards of identity relating to required weight per volume and solids content.

As a result of the instability of most aerated frozen desserts, producers have been required to manufacture the products locally to avoid the long periods of storage and temperature variations which are associated with national distribution from a few centrally located plants. Since most producers, distributors and retailers rely on deep freeze temperatures for preserving the quality of ice cream-type desserts during storage, distribution and sale, totally separate systems are rerquired for such products than are used for other frozen foods, which can be distributed at temperatures ranging from 0°F to 10°F. A very extensive network of frozen food storage, distribution and retailing facilities has been established nationwide, and therefore it can be seen that it would be extremely advantageous from an economic and efficiency standpoint if an ice cream-type aerated frozen dessert of acceptable quality and stability could also utilize this system.

Milkshakes and similar frozen shake beverages are representative of another type of aerated frozen food product in which poor stability has limited the storage and distribution systems which the manufacturer can utilize. As is well-known, milkshakes are usually manually prepared or dispensed from a commercial establishment for consumption on the premises. Various

attempts have been made in the past to provide products which are more widely available or are more susceptible to automated procedures. For example, milkshakes have simply been packaged in individual cups and frozen solid for distribution. The product is then warmed under controlled conditions to room temperature, agitated or otherwise mixed, and served. Another approach has been to prepare and distribute a frozen milkshake concentrate which serves as a base to which milk or water is added with agitation. Still another approach has been to aseptically can or bottle a prepared milkshake which is consumed after being chilled, shaken and opened. All of these prior approaches have either required unacceptably large amounts of time or space, required a reconstitutional step which is either difficult or time-consuming and/or have provided milkshakes which do not have the desired creaminess, coldness and consistency of commercially prepared milkshakes.

Since shakes are extremely popular items at fast food restaurants, it is of course important to reduce the time and labor involved in preparing large quantities of shakes manually. The present invention provides stable shakes which can be prepared in individual containers in central locations and shipped in a frozen state to various restaurant locations where they are stored and served at refrigeration temperatures without any on-site preparation.

Accordingly, it is an object of this invention to provide aerated frozen food products which are stable for sufficient periods of time to allow national distribution under conditions and temperatures encountered in 0°F frozen food systems. Another object is to provide an aerated frozen product which attains the aforesaid stability without a basic reformulation which would bring

the product outside the limits of consumer acceptance and regulatory standards. A still further object of the invention is to provide aerated frozen dessert products having the above attributes which are also soft and scoopable at freezer temperatuers. Another object is to provide shakes and similar beverages having the above attributes which retain the desirable characteristics of commercially prepared milkshakes when served at regrigeration temperatures (e.g. 15°F-25°F). A related object is to provide a frozen shake concentrate which can readily be reconstituted by the consumer into a high-quality shake.

In accordance with one aspect of the invention, a process for preparing an aerated frozen food product, wherein water, fat, protein, emulsifier and stabilizer are blended together to form a mix and said mix is homogenized to form an oil-in water emulsion which is subsequently whipped under freezing conditions, comprises:

selecting an edible oil which has an SFI of at least 25 to 70°F;

homogenizing said mix to form an emulsion of fat globules having a particle size wherein the average d_{vs} value is 0.2 to 1.5 microns, and a particle size distribution wherein the ratio of d_{vs} to d_{max} has a quotient in the range from 9 to 14;

aging the homogenized mix to crystallize said fat globules prior to said whipping and freezing; and

substantially retaining said particle size and particle size distribution after said whipping and freezing.

In accordance with the present invention, therefore, the fat component of the aerated frozen food product comprises an edible oil which has a solid fat index (SFI) of at least 25 at 70°F. The mix containing this fat is homogenized to form an emulsion of fat globules having an average volume/surface diameter (d_{vs}) of 0.2 to 1.5 microns, and a ratio of maximum fat globule diameter (d_{max}) to d_{vs} having a quotient of from 9 to 14. The emulsion is subsequently aged to crystallize the fat globules prior to whipping. The vast majority of the fat in the product, i.e. at least 94%, is in the form of fat dispersed in the aqueous phase with only a small amount, i.e. less than 6%, in the form of free or de-emulsified fat. The overrun of the aerated frozen food product is preferably from 50% to 110%.

The stable aerated frozen food products of the invention are extremely versatile and can be given a variety of textures and consistencies by varying the formulation. A preferred embodiment of the invention comprises a stable mellorine product having 52% to 57% water in the form of ice crystals and an aqueous phase, 10% to 15% of the aforementioned edible oil, 4% to 15% non-fat milk solids, and minor but effective amounts of stabilizer and emulsifier. Preferably, the whipping step is sufficient to provide an overrun in the range of 60% to 90% in order to produce mellorine having the textural characteristics and appearance of conventional ice cream. Products having the characteristics of soft-serve ice cream at 0°F may further comprise a freezing point depressant, preferably in the form of added sugars or other soluble solutes.

Ready-to-serve shake beverages having improved stability are also provided in accordance with this invention by increasing the amount of water in the above-

mentioned formulation and lowering the overrun to achieve the desired shake consistency. Preferred shakes of the invention comprise about 63% to 68% water, 3% to 9% of the aforementioned edible oil, and about 50% to 70% overrun. These shake products can be distributed through conventional frozen food systems in solid frozen form and then stored for several days at refrigeration temperatures (15°F to 25°F) before consumption without losing the desirable characteristics of commercially prepared milkshakes. The invention can also be employed to provide a frozen concentrate to which water or other liquids are added at room temperature with stirring to produce shake beverages.

It has quite unexpectedly been found that the selection and processing of the fat component during the preparation of the aforementioned aerated frozen food products are critical elements in achieving the unique stability of this invention. Because of the solid fat index (SFI) and other properties of the fat used, the small dispersed fat globules are substantially all crystallized during the aging step and a signficiant amount of these solid crystals are retained when the product is exposed to room temperature. Without intending to be bound by theory, it is thought that the mobility of the aqueous phase during thawing and refreezing of the product is significantly restricted by these finely distributed fat crystals, thereby resulting in products which develop less iciness and retain overrun better when exposed to heat shock than otherwise could be provided. This property in turn is thought to account in large part for the improved shelf life stability of the present products at typical frozen food temperatures.

Preparation in accordance with this invention results in aerated frozen food products which have sufficient stability to retain their desirable organoleptic properties for at least 50 days, and preferably as long as 180 days, at conditions which are normally encountered in typical 0°F frozen food storage, distribution and retailing systems. As a result, the products may be manufactured in a relatively few plants and distributed nationally and/or internationally using the same facilities as other frozen food items such as frozen vegetables, frozen entrees and frozen pizza. Frozen dessert products of the invention do not require a separate deep freezer in the retail store, and can be sold and/or consumed directly from the frozen food case or home freezer. The shake beverages of the invention can be delivered to the restaurant site frozen solid in individual containers and then stored and dispensed directly from a dispenser having a chamber in which the product has equilibrated to a temperature from 15°F to 25°F. Alternately, shakes can easily be prepared at home from a frozen concentrate of the invention stored in the home freezer. Preferably, 2 or 3 parts of frozen concentrate are diluted at room temperature (65°F to 75°F) with one part of water, or some other suitable liquid such as milk or juice, and then the diluted concentrate is stirred with a spoon to form the shake.

As briefly described above, the oils suitable for use in the practice of this invention have a Solid Fat Index (SFI) at 70°F of at least 25. SFI values are readily determined in accordance with standard analytical procedures using a dilatometer. Although the oil has a significant solid fat content at 70°F, it should be liquid at that temperature or easily liquefiable on warming and be substantially completely melted at about 100°F or slightly above. As used herein and in the claims the term

"oil" is intended to designate liquid fats meeting these requirements. Generally, the preferred oils are hydrogenated vegetable oils which have a (capillary) melting point between 70°F and 106°F, or blends of such vegetable oils. Suitable oils are derived from coconut, soybean, cottonseed, corn, palm kernel, peanut or the like. The solid fat in the most preferred oils melts quickly between 70°F and 100°F and these oils exhibit a sharp peak on a Differential Scanning Calorimetry curve. Since ice cream, ice milk, and milkshake standards require the use of butter fat, it is contemplated that high melting point fractions of butter oil meeting the SFI requirements of the invention could also be used to produce stable ice cream, ice milk, and milkshake products in accordance with this invention.

The amount of the fat component will vary depending on the aerated frozen food product being prepared and the particular organoleptic properties desired. Generally, the amount of the fat component comprises about 3% to 30% by weight of the frozen product, with the preferred mellorine products comprising 5% to 30% fat, most preferably 10% to 15% fat. The most preferred shake products of the invention comprise from 3% to 9% fat.

The fat component of this invention can be mixed with other ingredients at ambient temperatures but is preferably injected at an elevated temperature, e.g. about 160°F, into the aqueous mix containing the other ingredients. The resultant mixture is then homogenized, primarily to reduce the size of the fat globules and form a stable oil-in-water emulsion. In accordance with the preferred embodiment of the invention, the mix is homogenized at a low pressure, i.e., a total pressure below 6000 psig, to provide a uniform distribution of small fat globules in the emulsion.

The designations "d_{vs}" and "d_{max}" used herein and in the appended claims to characterize the particle size of the emulsion are derived from the spectroturbidimetry method described in detail by Walstra [P. Walstra, Estimating Globule-Size Distribution of Oil-in-Water Emulsions by Spectroturbidimetry. J. Coll. Interf. Sci. Vol. 27, No. 3, P. 493-500 (1968); and P. Walstra, Light Scattering by Milk Fat Globules, neth. Milk and Dairy J., Vol. 19, No. 2, P. 93-109 (1965)]. In general, this technique is based on the principle that the turbidity of an emulsion such as milk can be used to determine the average particle size and particle size distribution of the dispersed oil phase. In this method, a light beam is directed through the emulsion and the light scattering coefficient is taken as a function of a dimensionless number derived from the particle size of the suspended fat globules and the wavelength of the light. The transmittance and absorbance of the light beam incident on the emulsion contained in a standard cell is measured for various wavelengths using a spectrophotometer, and then these values are used to construct a light scattering spectrum. Homogenized emulsions typically show a log normal frequency-volume distribution, so a computer is used to generate a theoretical light scattering spectrum based on a log normal particle size distribution. The volume/surface average diameter of the fat globules (herein and in the claims referred to by the designation d_{vs}) and the maximum emulsion diameter (herein and in the claims referred to by the designation d_{max}) are mathematically calculated from the "fit" of the experimentally derived curve to the theoretical curve.

In accordance with the present invention, the mix is homogenized to provide a d_{vs} of 0.2 to 1.5 microns, preferably 0.2 to 0.5 microns, with the ratio of d_{max}/d_{vs} having a quotient of from 9 to 14. As previously stated,

this relatively narrow distribution of small fat globules in combination with the solid fat characteristics of the oil used has been found to be very important in achieving the improved shelf-life characteristics of the present invention.

Homogenizers commonly used in ice cream manufacture may be employed to homogenize the mix. Although homogenizing techniques not utilizing pressure may be used, a homogenization pressure not in excess of a total of 6000 psig is preferred. In fact, one advantage of the present invention is that the desired homogenization can be achieved at pressures lower than that usually employed in conventional ice cream manufacture, e.g. pressures below 3000 psig. Homogenization is preferably accomplished at temperatures of 110°F to 180°F.

The vigorous agitation of the mix during freezing and whipping inevitably results in some destabilization of the fat emulsion in the form of fat "churnout" or "de-emulsification", i.e., a coalescense wherein the fat globule loses its identity as a dispersed entity and forms pools, and/or "clumps" together to form larger particles. In addition, the emulsion prior to whipping may inherently contain some of this "free" fat. The current understanding in the ice cream art is that such physical properties as dryness and stiffness are related to the degree of de-emulsification of the fat. It is believed that too little de-emulsification results in a wetter-appearing and less stiff ice cream, whereas too much de-emulsification may result in a courser texture. In addition, a coating of de-emulsified fat around the air cells tends to improve the foam stability of the product and is considered desirable. However, too much de-emulsified fat in the continuous phase may give a fatty or too creamy sensation to the frozen product.

It has quite surprisingly been found that the products of this invention exhibit considerably less fat de-emulsification, or free fat, than conventional frozen desserts and shake products. In the present products, at least 94% of the total fat is in the emulsified form and less than 6% of the total fat is in the de-emulsified form, whereas conventional ice cream, for example, typically has about 13% of the total fat in the de-emulsified form. The relatively narrow distribution of small fat crystals produced as a result of the homogenization and aging steps of the invention is substantially retained after the freezing and aeration step and this in turn is believed to contribute to this low incidence of de-emulsified fat.

De-emulsified fat can be extracted by hydrophobic organic solvents such as chloroform because of its "free" character, whereas emulsified fat cannot. Therefore, the level of de-emulsified fat in the frozen product can readily be determined by mixing a sample with chloroform, removing the chloroform soluble fraction, evaporating the chloroform and weighing the residue. De-emulsified fat so determined is then expressed as a percentage of the total fat.

The fat component of the invention may be used with mono and diglyceride emulsifiers and other emulsifiers normally used in aerated frozen food products and/or permitted by the applicable standards of identity. Such emulsifiers are typically used in amounts ranging from 0.1% to 0.5%, preferably less than 0.3%. The emulsifiers may be conveniently melted with the fat component and metered together into the mix prior to homogenization.

The mix may be pasteurized before or after homogenization in accordance with known commercial procedures. For example, continuous high temperature/short time (HTST) pasteurization is the most common method used by the larger ice cream plants and is suitable for the practice of the present invention. Minimum pasteurization standards for ice cream mix recommended by the U.S. Public Health Service are 175°F for 25 seconds for the HTST method, and 155°F for 30 minutes for the alternative holding method.

Following homogenization and pasteurization, the mix is rapidly cooled and held ("aged") at 30°F to 45°F for a time sufficient to cause extensive crystallization of the fat globules, usually from 2 to 12 hours. It is believed that the resultant distribution of small fat crystals which retain a significant amount of solid fat at room temperature not only aids in the freeze-thaw stability of the product by providing physical barriers limiting the mobility of the aqueous phase, but also contributes to improved physical properties of the frozen product, such as a smoother texture.

After sufficient aging, the mix is simultaneously aerated ("whipped") and frozen in the conventional manner. In a continuous freezer, the mix is rapidly cooled to freezing temperature and air is simultaneously incorporated to form the basic foam structure of small uniformly dispersed air cells. These processes take place under conditions of vigorous agitation provided by a "mutator", a rotating cylindrical device equipped with scraper blades and a whipping mechanism. The residence time during freezing is usually on the order of 25 to 30 seconds. As freezing proceeds, the mass becomes increasingly viscous and is finally extruded into containers from the freezer in a stiff plastic condition.

The product may then be further frozen (hardened) at a temperature of about -40°F to -80°F prior to storage at typical frozen conditions.

The amount of incorporated air, i.e., the "overrun", is important to the overall stability of aerated frozen products, yet must be controlled within certain limits to provide an acceptable texture and appearance. Generally, the higher the overrun, the lower the amount of water per unit of volume, and therefore the more resistant the product is to the formation of the large ice crystals after heat shock. Although high overrun aerated frozen products exhibit increased stability, increasing the overrun to improve the stability will not always produce an acceptable product since there are limits placed on the amount of air incorporated in the product, both by the various standards of identity and consumer preference. For example, federal regulations on solids content and weight/volume relationships for ice cream and related products, such as mellorine and ice milk, effectively limit the overrun to about 110%. Frozen desserts having overruns in excess of this amount tend to exhibit textural properties which are not characteristic of ice cream, and therefore are not preferred by consumers. The practice of the present invention is particularly advantageous for stabilizing ice cream-type frozen desserts without requiring overruns over 110%. Although products of this invention generally comprise less water than conventional ice cream-type products, they have similar overrun so as to retain the familiar textural properties of ice cream. Preferably, the frozen mellorine desserts and shake concentrates described herein comprise from 45% to 68% water, with 52% to 57% water being the most preferred range. Overrun for these products is usually from 50% to 110%, preferably about 60% to 90%.

There are no existing standards which dictate the amount of overrun in milkshakes and similar frozen shake produts. However, such products usually become too foamy to be acceptable at overruns of 80% or over, and too liquid or thin at overruns of 30% or below. For the ready-to-serve frozen shakes of this invention, the preferred water content is 63% to 68% and the preferred overrun is about 50% to 70%.

A stable foam (aerated) phase imparts a structural rigidity to the subject frozen food products and aids in limiting the mobility of the aqueous phase which causes the separation of the phases during prolonged storage. To this end, foam stabilizers are useful in the practice of the present invention. Among the most useful stabilizers are the hydrophilic colloids, or hydrocolloids, commonly referred to as "gums". These long-chain high-molecular-weight polymers disperse in the aqueous phase and/or interact with other product ingredients to provide a thickning or gelling effect which stabilizes the foam structure. They also contribute to the stability of the product by serving as water-binding ingredients which limit the mobility of the aqueous phase. Common gums suitable for use in the present invention include natural gums such as carrageenan, guar gum, locust bean gum, xanthan gum, gelatin, alginates, pectin, dextran, glucan and the like, as well as modified natural gums such as carboxymethyl cellulose, methylcellulose ether and other modified cellulose derivatives, modified starch, polyacrylic acid, and the like, and various mixtures thereof. The permitted quantities of gums may be governed by federal and/or state regulations, as well as by consumer preference regarding such physical properties as mouth feel and melt-down rate. The unique stability characteristics of the products of this invention allow

very small amounts of stabilizers to be used, preferably quantities much less than 1% and most preferably less than 0.3%.

Aerated frozen dessert products of the invention may be given hardness and texture at 0°F which simulate that of commercially available soft-serve ice cream. Conventional soft-serve ice cream products are usually prepared using machinery located on the premises where they are consumed and are served at temperatures slightly below freezing, e.g., 15°-25°F. Accordingly, these products characteristically have poor keeping qualities which prevent their effective distribution and storage off premises. If exposed to the deep freeze temperatures necessary to prolong their shelf life, conventional soft-serve products become very hard and cannot be scooped from a container for serving. To solve this problem, aerated frozen dessert products sometimes include greater than normal quantities of sugars, alcohols and other low molecular weight compounds to lower the freezing point of the aqueous phase to an extent where the product is soft and scoopable and has a soft-serve texture at freezer temperatures. Frozen shake concentrates are also made more easily dispersible by the addition of such compounds. It has been found that the use of such freezing point depressants is compatible with he practice of the present invention and that the unique stability of the products can readily be achieved with formulations including such compounds.

The most useful freezing point depressants in the practice of this invention are sugars which not only have a sweetening effect, but also enhance the creamy texture of the product. The choice of sugars employed is controlled by the degree of freezing point depression desired and also by flavor and texture effects resulting

from the addition of such sugars. An insufficient amount of sugar will produce an off-taste in the product, whereas too much sugar will produce excessive sweetness and may mask other desirable flavors. Different sugars also lower the freezing point of the product to varying degrees, depending on their molecular weights.

Preferably, the amount of added sugars in the products of this invention is 18% to 33% by weight. It has been found that the most desirable balance of sweetness and textural properties may be achieved by employing sucrose in combination with one or more sugars which are less sweet; for example, sucrose may be combined with dextrose, lactose, low-conversion corn syrup, etc; in order to obtain the benefits of a relatively large proportion of sugar at a level of sweetness which is less than that resulting from the use of an equal amount of sucrose alone.

The products of this invention comprise 4% to 15% non-fat milk solids. Although non-fat milk solids are the preferred source of protein, it is contemplated that other suitable frozen dessert proteins, such as casein, caseinates, whey protein concentrate, egg protein, and soy, peanut and/or vegetable proteins may be used. Non-fat milk solids are the solids of skim milk and can be added in dry form or as condensed skim milk. These solids include proteins, minerals and milk sugar. Milk sugar adds to the sweet taste of the frozen product and proteins aid in the development of the desired overrun as well as contribute to the desirable texture and body of the product. The use of larger amounts of non-fat milk solids increases the effect that whipping has on the frozen product and increases the viscosity and resistance to melting of the composition. They also tend to lower the freezing point of the product. Non-fact milk solids which

contain not less than 2.5 mg/g undenatured whey protein nitrogen per gram of milk solids, as determined by the procedure set forth in American Dry Milk Institute Bulletin 916, are preferred.

The following examples are intended to illustrate the present invention, and are not to be construed as limiting the invention in any way:

Example I

A series of six frozen aerated desserts were prepared containing the following ingredients in parts by weight:

	Parts/Weight
Non-fat Dry Milk Solids	6.60
Fat Component	12.00
Dextrose	21.2
Sucrose	4.10
Corn Syrup	2.40
Xanthan Gum	0.264
Carrageenan	0.004
Emulsifier	0.10
Flavoring	0.40
Coloring	0.84
Water	52.10

The samples were made according to the following procedure:

48 pounds of the fat component was melted with 0.4 pounds of the emulsifier component by heating to a temperature of 110°F in a 70 gal. jacketed container to form the fat phase. 26.4 pounds of non-fat dry milk solids was dispersed in 206 pounds of water and the

remaining ingredients (122 pounds) were added to form the aqueous phase. The fat and aqueous phases were mixed together at 160°F, homogenized at a pressure of 1500 psi, and the emulsion thus formed was pasteurized at 175°F for 25 seconds. The mix was then cooled to between 30°F and 40°F and aged for 12 hours at 40°F. The aged mix was aerated in an ice cream freezer at about 16°F to provide an overrun of about 75%, extruded into suitable containers, hardened at a temperature of -40°F to -80°F and stored in a 0°F freezer.

The SFI values of the fat components employed in the six samples were as follows:

Sample SFI at 100°F	Fat Component	SFI at 70°F
A	Coconut Oil	46.10
B	Coconut Oil	37.40
C	Coconut Oil	26.60
D	Soy/Coconut Oil Blend	20.00
E	Soybean Oil	16.90
F	Anhydrous Butter	13.80

The average fat particle size (d_{vs}) of each sample was from 0.2 to 0.5 microns, and the d_{max}/d_{vs} quotient was in the range from 9 to 14. The amount of free fat for each sample was 2% to 3% using the chloroform extraction method.

The samples were subjected to conditions which were representative of those encountered in a typical 0°F distribution system. Samples in their containers on a "mock" pallet were removed from the 0°F freezer, kept for

2-4 hours at room temperature (about 70°F), and then placed back in the 0°F freezer for 20-22 hours. This procedure was repeated 4 or 5 times.

After undergoing the above freeze-thaw cycles, the samples were submitted to test panels consisting of 10 to 15 people, who were asked to rate them for iciness and softness. Samples A, B, and C incorporaing the present invention were judged by the panels to be acceptable, whereas the remaining samples not incorporating the invention were determined to be unacceptable.

Example II

A Sample G employing the coconut oil of Sample B was prepared and subjected to heat shock in accordance with the procedure described in Example I, except that Sample G was prepared in a low shear device (i.e. an Oakes mixer) to provide an average particle size (d_{vs}) of 6.4 microns and a ratio of d_{max} to d_{vs} having a quotient of 2.0. Sample G was considered to be unacceptably unstable to heat shock and was judged to be icy and coarse by the evaluation panel.

Example III

A frozen shake product was prepared using the procedure of Example I and the following formula:

	Parts/Weight
Non-fat Dry Milk Solids	10.000
Coconut Oil	5.715
Dextrose	14.000
Sucrose	6.000
Xanthan Gum	0.175
Carrageenan	0.060
Emulsifier	0.100
Flavoring	0.400
Coloring	0.400
Water	63.150
Overrun	60%

This product (Sample H) was extruded into a 14 fl. oz. waxed paper cup and placed in a 20°F refrigerator along with a prior art frozen shake (Sample I) made in accordance with Arbuckle U.S. Pat. No. 3,479,187. Samples H and I were taken from the refrigerator, and along with Sample J, a typical fast food restaurant shake, they were allowed to sit at room temperature (72.4°F) for 40 minutes. Both Sample I and J exhibited symptoms of instability after this time. Sample J developed a phase separation band about 2 cm wide at the bottom, and large (about 0.3 cm diameter) air bubbles on the top to give a very foamy appearance. Sample I developed a rim of fluid around an unappealing icy lump in the center of the shake. However, there were no significant changes observed in Sample H, during this time period, thereby demonstrating the superior stability of the shake beverages of the present invention when compared to prior art products.

CLAIMS:

1. A process for preparing an aerated frozen food product, wherein water, fat, protein, emulsifier and stabilizer are blended together to form a mix and said mix is homogenized to form an oil-in-water emulsion which is subsequently whipped under freezing conditions, characterized in that it comprises:

selecting an edible oil which has an SFI of at least 25 at 70°F;

homogenizing said mix to form an emulsion of fat globules having a particle size wherein the average d_{vs} value is 0.2 to 1.5 microns, and a particle size distribution wherein the ratio of d_{vs} to d_{max} has a quotient in the range from 9 to 14;

aging the homogenized mix to crystallize the fat globules prior to the whipping and freezing; and

substantially retaining the particle size and particle size distribution after the whipping and freezing.

2. A process as defined in claim 1, characterized in that the mix is homogenized at a pressure less than 6000 psig.

3. A process as defined in claim 1 or claim 2 characterized in that the homogenized mix is aged at 30°F to 45°F for 2 to 12 hours prior to whipping and freezing.

4. A process as defined in any one of claims 1 to 3, characterized in that the aged mix is whipped to an overrun of 50% to 110% to provide a frozen dessert product.

5. A process as defined in any one of claims 1 to 3, characterized in that the aged mix is whipped to an overrun of about 50% to 70% to provide a frozen shake product.

6. A process for preparing a stable aerated frozen dessert product, characterized in that the process comprises the steps of:

mixing 45% to 68% water, 3% to 30% edible oil having an SFI of at least 25 to 70°F, 4% to 15% non-fat milk solids, and minor but effective amounts of stabilizer and emulsifier to form a mix;

homogenizing said mix to form an emulsion of fat globules having a particle size wherein the average d_{vs} value is 0.2 to 1.5 microns and a particle size distribution wherein the ratio of d_{vs} value is 0.2 to 1.5 microns and a particle size distribution wherein the ratio of d_{vs} to d_{max} has a quotient of from 9 to 14;

aging the homogenized mix at 30°F to 45°F for 2 to 12 hours to crystallize said fat globules;

whipping the aged mix under freezing conditions to an overrun of 50% to 110%; and

substantially retaining said particle size and particle size distribution after said whipping and freezing.

7. A process as defined in claim 6, characterized in that the oil and emulsifier are melted together and injected just prior to homogenization into a solution of the remaining ingredients in the water.

8. A process as defined in claim 6, characterized in that the aerated frozen dessert is hardened at -40°F to -80°F after whipping.

9. A process as defined in claim 8, characterized in that the hardened aerated frozen dessert is stored, distributed, sold and consumed at 0°F to 10°F.

10. A process as defined in claim 8, characterized in that 2 to 3 parts of the aerated frozen dessert are diluted at room temperature with one part of liquid and stirred to form a shake beverage.

11. A process for preparing a stable shake beverage, characterized in that the process comprises:

mixing 63% to 68% water, 3% to 9% edible oil having an SFI of at least 25 to 70°F, 4% to 15% non-fat milk solids, and minor but effective amounts of stabilizer and emulsifier to form a mix;

homogenizing said mix to form an emulsion of fat globules having a particle size wherein the average d_{vs} value is 0.2 to 1.5 microns and a particle size distribution wherein the ratio of d_{max} to d_{vs} has a quotient of from 9 to 14;

aging the homogenized mix at 30°F to 45°F for 2 to 12 hours to crystallize said fat globules;

whipping the aged mix under freezing conditions to an overrun of 50% to 70%;

substantially retaining said particle size and particle size distribution after said whipping and freezing;

placing the aerated frozen product into individual containers; and

allowing said aerated frozen product to equilibriate to a temperature of from 15°F to 25°F until it develops a shake consistency.

12. A process as defined in claim 11, characterized in that the aerated frozen product is hardened at -40°F to -80°F after it is placed into individual containers.

13. A stable aerated frozen food product characterized in that it is formed by a process which comprises the steps of:

mixing 45% to 68% water, 3% to 30% edible oil having an SFI of at least 25 to 70°F, 4% to 15% non-fat milk solids, and minor but effective amounts of stabilizer and emulsifier to form a mix;

homogenizing said mix to form an emulsion of fat globules having a particle size wherein the average d_{vs} value is 0.2 to 1.5 microns and a particle size distribution wherein the ratio d_{vs} to d_{max} has a quotient of from 9 to 14;

aging the homogenized mix at 30°F to 45°F for 2 to 12 hours to crystallize said fat globules;

whipping the aged mix under freezing conditions to an overrun of 50% to 110%; and

substantially retaining said particle size and particle size distribution after said whipping and freezing.

14. A stable ready to serve shake beverage, characterized in that it is formed by a process which comprises:

mixing 63% to 68% water, 3% to 9% edible oil having an SFI of at least 25 to 70°F, 4% to 15% non-fat milk solids, and minor but effective amounts of stabilizer and emulsifier to form a mix;

homogenizing said mix to form an emulsion of fat globules having a particle size wherein the average d_{vs} value is 0.2 to 1.5 microns and a particle size distribution wherein the ratio of d_{max} to d_{vs} has a quotient of from 9 to 14;

aging the homogenized mix at 30°F to 45°F for 2 to 12 hours to crystallize said fat globules;

whipping the aged mix under freezing conditions to an overrun of 50% to 70%;

substantially retaining said particle size and particle size distribution after said whipping and freezing;

placing the aerated frozen product into individual containers; and

allowing said aerated frozen product to equilibriate to a temperature of from 15°F to 25°F until it develops a shake consistency.

15. A product as defined in claim 14, characterized in that it has an overrun of 50% to 110%.

16. A product as defined in claim 14 or claim 15, characterized in that at least 94% of said oil is dispersed in said aqueous phase in the form of said crystallized fat particles and less than 6% of said oil is in the form of de-emulsified fat.

17. A food product whenever formed by the process as claimed in any one of claims 1 to 12.

18. A stable aerated frozen food product, characterized in that it comprises:

45% to 68% water in the form of ice crystals and an aqueous phase;

4% to 15% non-fat milk solids;

3% to 30% edible oil having an SFI of at least 25 at 70°F, a majority of said oil being dispersed in said aqueous phase in the form of crystallized fat particles having a d_{vs} value of 0.2 to 1.5 microns and a ratio of d_{max} to d_{vs} having a quotient of from 9 to 14; and

minor, but effective, amounts of emulsifer and stabilizer.

19. A product as defined in claim 18, characterized in that it has an overrun of 50% to 110%.

20. A product as defined in claim 18, characterized in that at least 94% of said oil is dispersedin said aqueous phase in the form of said crystallized fat particles and less than 6% of said oil is in the form of de-emulsified fat.

21. A product as defined in claim 18, characterized in that it further comprises a hydrocolloid stabilizer system in a quntity less than 1%.

22. A product as defined in claim 18, characterized in that it comprises 0.1% to 0.5% emulsifier.

23. A stable frozen mellorine product, characterized in that it comprises:

52% to 57% water in the form of ice crystals and an aqueous phase;

4% to 15% non-fat milk solids;

10% to 15% edible oil having an SFI of at least 25 at 70°F, at least 94% of said oil being dispersed in said aqueous phase in the form of crystallized fat particles having a d_{vs} value of 0.2 to 0.5 microns and a ratio of d_{max} to d_{vs} having a quotient of from 9 to 14, and less than 6% of said oil in the form of de-emulsified fat;

18% to 33% added sugars; and

an overrun of 60% to 90%.

24. A stable ready-to-serve shake beverage characterized in that it comprises:

63% to 68% water in the form of ice crystals and an aqueous phase:

4% to 15% non-fat milk solids;

3% to 9% edible oil having an SFI of at least 25 at 70°F, at least 94% of said oil being dispersed in said aqueous phase in the form of crystallized fat particles having a d_{vs} value of 0.2 to 1.5 microns and a ratio of d_{max} to d_{vs} having aquotient of from 9 to 14, and less than 6% of said oil in the form of de-emulsified fat;

18% to 33% added sugars;

0.1% to 0.3% mono- and/or di-glyceride emulsifiers;

less than 0.3% of a hydrocolloid stabilizer; and

an overrun of 50% to 70%.

European Patent Office

EUROPEAN SEARCH REPORT

0147483
Application number

EP 83 11 3183

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Y	US-A-3 914 440 (RALPH P. WITZIG) * Column 2, lines 5-14; column 3, line 61 - column 4, line 3 * ---	1,2,6, 9,17	A 23 G 9/02 A 23 G 9/04
Y	US-A-4 421 778 (MARVIN L. KAHN et al.) * Column 3, lines 25-27; column 6, lines 25-30; claims 1,25 * ---	1,2-6, 9,10, 17	
Y	GB-A-2 045 050 (D. TRESSER) * Page 3, lines 50-60; page 2, lines 20-27 * ---	1,2,4-6,17	
Y	US-A-4 368 211 (J.R. BLAKE et al.) * Column 7, lines 20-25; examples 1-3; column 8, lines 30-41 * ---	1-10, 17	TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
Y	MILK PLANT MONTHLY, June 1948, pages 42-50; L.L. LITTLE: "Emulsifying and stabilizing agents for ice cream" * Page 44, column 2, paragraph 2; page 50, column 2, paragraph 4 * --- -/-	1	A 23 G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27-07-1984	GUYON R.H.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

European Patent Office

EUROPEAN SEARCH REPORT

0147483
Application number

EP 83 11 3183

Page 2

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Y	US-A-4 031 261 (J.R. DURST) * Examples 1-13; column 3, lines 14-24; claim 15; column 12, lines 30-35; column 6, lines 50-68 *	1,9,10,17	
A	US-A-3 431 117 (G.J. LORANT) * Column 2, lines 34-37; column 3, lines 45-50; column 3, lines 15-17; claims 1-8 *	1	
A	US-A-3 889 001 (N.F. BUIDE et al.)		
A	FR-A- 868 427 (SOC. ASTRA) * Abstract no. 1a *	7	
A	US-A-4 346 120 (R.G. MORLEY et al.)		TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
A	US-A-3 949 102 (J.A. HELLYER et al.)		
E,X	US-A-4 434 186 (NITIN DESIA et al.)	1-24	
A	US-A-3 993 793 (D.J. FINNEY)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27-07-1984	GUYON R.H.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

English translation of German Utility Model Application DE 20202557.8

Published July 25, 2002

DESCRIPTION

Mounting for a device for the dispensing of a cooled portion of ice cream

The present invention relates to a mounting for a device for the dispensing of a cooled portion of ice cream, the cooled portion of ice cream being made available in a cartridge.

A device for the dispensing of a cooled portion of ice cream is described for example in WO 01/78520 A1. With the known device there is provided a cartridge with a portion of ice cream located therein, which is tempered to a dispensing temperature of about -10°C. The cartridge is closed at its one end face by means of a cover, which has an exit opening, and at its other end face by means of a piston moveable in the cartridge. The known device has a holder element for the cartridge and a holder element for an ice cream cone or an ice cream tub. Thereby, the two holder elements are so formed on the device that the exit opening of the cartridge and the ice cream cone or the ice cream tub are arranged vertically above one another when the cartridge is in place and the ice cream cone/tub is in place. For dispensing the cooled portion of ice cream located in the cartridge the piston located in the cartridge is moved by means of a delivery device, actuated manually or via a lever, in the direction of the dispensing opening of the cartridge, so that the portion of ice cream located in the cartridge is dispensed through the dispensing opening into the cone located therebelow.

Generally the known devices for the dispensing of a cooled portion of ice cream are so configured that they can be arranged free-standing for example on a table or the lid of a freezer chest or cabinet. It would mean a

disproportionate waste of e.g. sales area, to provide a table specially for the device for the dispensing of a cooled portion of ice cream. On the other hand, the placing of the device on the lid of a freezer chest strongly hinders the removal of the foodstuffs located in the freezer chest. Thus it is also known to fix, for example to a freezer chest containing the cartridges with the cooled portions of ice cream, a special small table for the device for the dispensing of a cooled portion of ice cream. Thereby, the size of the small table is matched to the device for the dispensing of a cooled portion of ice cream.

The known small table for the device for the dispensing of a cooled portion of ice cream is illustrated in Fig. 6. The illustrated small repository table has two U-shaped elements 61 each with a longer limb 62. The U-shaped elements 61 are formed to be hooked into an upper edge strip 64 of a freezer chest 65 and carry a horizontal table top 66 which is adapted in size to the device. Thereby the U-shaped elements 61 support themselves with their longer limbs 62 on a side wall of the freezer chest 65, so that the table top 66 is held in the horizontal by the U-shaped elements 61.

With the known repository table for the device for the dispensing of a cooled portion of ice cream it is disadvantageous that beyond the area taken up by the freezer chest a further area must be made available for the small table. Further it is disadvantageous that the device is only loosely arranged on the table top of the small table and thus can easily fall down. Additionally it is disadvantageous that the device, through the arrangement of the table at an edge region outside the freezer chest, is only poorly accessible in particular when there are a number of operators. Also, the U-shaped elements of the known small table can readily be hooked out of the edge strip of the freezer chest through unintended knocking of

the small table, so that the small table together with the device for the dispensing of a cooled portion of ice cream falls to the floor.

Starting from this, it is the object of the present invention to make available a mounting for a device for the dispensing of a cooled portion of ice cream which manifests a minimal requirement for space and is suitable to hold the device at a readily accessible disposition.

The object is achieved by means of the features of independent claim 1. The invention is further developed in the subclaims.

In accordance with the present invention, a mounting for a device for the dispensing of a cooled portion of ice cream, the cooled portion of ice cream being made available in an ice cream cartridge, is proposed whereby the mounting includes a base plate for the device which is formed to be releasably fixed to an upper edge region of a freezer chest, whereby the base plate has two fixing elements which include with one another an angle greater than zero degrees and are configured to come into releasable engagement with sections of the upper edge region of the freezer chest which include the same angle with one another, and the base plate further carries a vertical column which is configured to hold the device for the dispensing of a cooled portion of ice cream.

With the mounting proposed in accordance with the invention it is possible to arrange a device for the dispensing of a cooled portion of ice cream above a freezer chest, so that the mounting in accordance with the invention takes up no additional area. Further, the device arranged by means of the claimed mounting is well accessible also for a plurality of users, since the device can be arranged within the area taken up by the freezer chest, and thus as a rule

can be readily reached from all sides of the freezer chest. Since the device in accordance with the present invention is further held by a column, which in turn is carried by a base plate of the mounting, the mounting in accordance with the invention can effectively prevent that the device is unintentionally tipped over, falls to the floor and is contaminated or damaged.

If the device for the dispensing of a cooled portion of ice cream is to be able to be operated alternately by a number of users it is particularly advantageous if the column of the mounting in accordance with the invention is configured to allow a rotation around the column of a device for the dispensing of a portion of cooled ice cream held by the column, since the device can thus be made optimally accessible to each user by simple rotating.

In order to avoid falling down of the mounting in accordance with the invention as a whole, the two fixing elements are in accordance with a preferred exemplary embodiment configured to come into a snap connection with the edge region of the freezer chest. In accordance with an alternative embodiment the two fixing elements may however be so configured as to come into a clamping connection with the edge region of the freezer chest.

Further, the mounting in accordance with the invention can be fastened to a freezer chest in a particularly rapid and uncomplicated manner by means of the configuration of the two fixing elements for a snap or clamping connection.

In accordance with a particularly preferred embodiment it is of advantage if the mounting further has a carrier arm which is rotatably attached to the column and includes with the column an angle of inclination greater than zero degrees, whereby the device for the dispensing of a cooled portion of ice cream is attached to the carrier arm so that

in a simple manner a defined inclination of the device with respect to the vertical can be obtained, which makes it possible for the user to check the functioning of the device comfortably visually.

In order to further ensure good accessability to the goods located in the freezer chest it is particularly advantageous if the two fixing elements and the base plate are so configured that a sliding lid of the freezer chest arranged below the base plate can be displaced.

So that the device in accordance with the invention can be arranged upon a commonplace freezer chest having a rectangular basic shape, the two fixing elements include with one another preferably an angle of 90 degrees.

In the following, the invention will be described in more detail with reference to Figures, which show:-

Fig.1	schematically the structure of a mounting for a device for the dispensing of a cooled portion of ice cream according to the invention, in accordance with a first preferred embodiment;
Figs. 2, 3 & 4	alternative configurations of the fixing elements of the mounting in accordance with the invention, in cross-section;
Fig. 5	schematically the structure of a mounting for a device for the dispensing of a cooled portion of ice cream according to the invention, in accordance with a second preferred embodiment;
Fig. 6	schematically the structure of a small table

for a device for the dispensing of a cooled portion of ice cream, in accordance with the state of the art.

In Figs. 1 to 5 the same elements are provided with the same reference signs.

Fig. 1 shows schematically the structure of a first preferred embodiment of a mounting in accordance with the present invention, for a device 1 for the dispensing of a cooled portion of ice cream, the cooled portion of ice cream being made available in a cartridge 2.

The mounting shown in Fig. 1 includes a base plate 6 which has two fixing elements 3_1, 3_2, the two fixing elements 3_1, 3_2 including with one another in the horizontal an angle ß greater than zero degrees. The fixing elements 3_1, 3_2 are so configured that they can releasably come into engagement with sections of the upper edge region 4 of a freezer chest 5 which include in the horizontal the same angle ß. Thereby the base plate 6 and the two fixing elements 3_1, 3_2 are preferably so configured that a sliding lid 8 of the freezer chest 5 arranged below the base plate 6 can be displaced when the mounting is mounted. In the preferred embodiment illustrated in Fig. 1, the base plate 6 and the fixing elements 3_1, 3_2 are formed in one piece of sheet metal. Alternatively, these elements may however be formed for example of plastics or be assembled of different materials.

In the illustrated preferred embodiment the angle ß between the fixing elements 3_1, 3_2 is ninety degrees, so that the fixing elements 3_1, 3_2 can be arranged in a corner region of a freezer chest 5 having a rectangular shape and come into engagement with corresponding sections of the edge region 4 of the freezer chest 5.

Generally it is however advantageous if the angle ß between the fixing elements 3_1, 3_2 is between 45 degrees and 135 degrees, since the spatial three-legged form spanned by the fixing elements 3_1, 3_2, which carries the base plate 6, has a particularly good stability in this range of angles. Consequently, with such a construction of the mounting in accordance of the invention there can be omitted a generally very advantageous force-fit connection between the fixing elements 3_1, 3_2 and edge region 4 of the freezer chest 5.

Thus it is possible to so configure the fixing elements 3_1, 3_2 for example that they can be placed into a groove which is formed in the edge region 4 of the freezer chest 5. This is illustrated in Fig. 3 and allows a particularly flexible positioning of the mounting in accordance with the invention on the freezer chest 5.

As is shown in Figs. 2 and 4 it is however alternatively particularly advantageous to so configure the fixing elements 3_1, 3_2 that they come into a clamping connection or snap connection with the edge region 4 of the freezer chest 5. Thereby, an engagement around the edge region 4 can also be effected. By means of the provision of such a releasable force-fit connection between the fixing elements 3_1, 3_2 and the edge region 4 of the freezer chest 5 the mounting in accordance with the invention can be particularly reliably secured against falling down. Further, the mounting in accordance with the invention can thus be provided also on freezer chests 5 for which the spatial three-legged form spanned by the fixing elements 3_1, 3_2, due to an unfavourable development of the edge region 4 and an unfavourable angle ß resulting therefrom, would not alone guarantee sufficient stability of the mounting.

If the freezer chest has, in contrast, an oval or round shape as is illustrated in Fig. 5 with regard to a second

preferred embodiment of the mounting in accordance with the invention, the fixing elements 3_1, 3_2 of the mounting in accordance with the invention are to be so configured that they come into engagement with sections of the upper edge region 4 of a freezer chest 5 the tangents of which include the same angle ß as the fixing elements 3_1, 3_2. With such a configuration it is further advantageous to configure the fixing elements 3_1, 3_2 to be arc shaped.

As is further evident from Figs. 1 and 5, the base plate 6 carries a vertical column 7 which holds the device 1 for the dispensing of a cooled portion of ice cream.

Thereby there is attached - as illustrated in Fig. 1 - to the column 7 preferably a carrier arm 9 for the device 1, which includes with the column 7 an angle of inclination α greater than zero degrees and which is rotatable around the column 7.

Consequently the device 1 attached to the carrier arm 9 is also inclined with respect to the column 7 and thus with respect to the vertical, which facilitates a comfortable visual checking of the device 1 by the user and makes possible a reliable operation of the device 1. An angle of inclination α of between 5° and 20°, and in particular between 10° and 15° with respect to the vertical has proved to be particularly advantageous.

Alternatively, the device 1 can however be held to be directly rotatable (or also fixed against rotation) by the column 7, as is illustrated in Fig. 5.

An arrangement of the device 1 to be rotatable around the column 7 of the mounting in accordance with the invention thereby allows, also for a plurality of users, particularly comfortable operation of the device 1, since the device 1 can rapidly and simply be made accessible for a user

through rotation.

Thus, it is possible with the mounting proposed in accordance with the invention to arrange a device 1 for the dispensing of a cooled portion of ice cream above a freezer chest 5, so that the mounting in accordance with the invention takes up no additional area. Further, the device mounted with the mounting in accordance with the invention is, due to its relatively central arrangement, well accessible even for a plurality of users and secured against falling down by the column 7 carried by base plate 6 of the mounting. A good accessability of the goods located in the freezer chest 5 can also be further ensured, since the movement of the sliding lid 8 of the freezer chest 5 is preferably not restricted by the mounting in accordance with the invention.

CLAIMS

1. Mounting for a device (1) for the dispensing of a cooled portion of ice cream, the cooled portion of ice cream being made available in an ice cream cartridge (2), the mounting including a base plate (6) for the device (1) which is configured to be releasably fixed on an upper edge region (4) of a freezer chest (5), characterized in that, the base plate (6) has two fixing elements (3_1, 3_2) which include with one another an angle (ß) greater than zero degrees and are configured to come into releasable engagement with sections of the upper edge region (4) of the freezer chest (5) which include the same angle (ß) with one another, and in that the base plate (6) further carries a vertical column (7) which is configured to hold the device (1) for the dispensing of a cooled portion of ice cream.

2. Mounting according to claim 1, characterized in that, the column (7) is configured to allow a rotation around the column (7) of a device (1) for the dispensing of a cooled portion of ice cream which is held by the column (7).

3. Mounting according to claim 1 or 2, characterized in that, the two fixing elements (3_1, 3_2) are configured to come into a snap connection with the edge region (4) of the freezer chest (5).

4. Mounting according to claim 1 or 2, characterized in that, the two fixing elements (3_1, 3_2) are configured to come into a clamping connection with the edge region (4) of the freezer chest (5).

5. Mounting according to any preceding claim, characterized in that, the mounting further has a carrier arm (9) which is rotatably fixed to the column (7) and includes with the column (7) an angle of inclination (α) greater than zero degrees, whereby the device (1) for the dispensing of a cooled portion of ice cream is fixed to the carrier arm (9).

6. Mounting according to any preceding claim, characterized in that, the two fixing elements (3_1, 3_2) and the base plate (6) are so configured that a sliding lid (8) of the freezer chest (5) arranged below the base plate (6) can be displaced.

7. Mounting according to any preceding claim, characterized in that, the two fixing elements (3_1, 3_2) include with one another an angle (β) of ninety degrees.

ABSTRACT

According to the present invention there is proposed a mounting for a device 1 for the dispensing of a cooled portion of ice cream, the cooled portion of ice cream being made available in an ice cream cartridge 2, the mounting including a base plate 6 for the device 1 which is configured to be releasably fixed on an upper edge region 4 of a freezer chest 5, and the base plate 6 has two fixing elements 3_1, 3_2 which include with one another an angle ß greater than zero degrees and are configured to come into releasable engagement with sections of the upper edge region 4 of the freezer chest 5 which include the same angle ß with one another, and whereby the base plate 6 further carries a vertical column 7 which is configured to hold the device 1 for the dispensing of a cooled portion of ice cream.

(Figure 1)

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 321 043 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.06.2003 Bulletin 2003/26

(51) Int Cl.7: A23G 9/02

(21) Application number: 02258414.8

(22) Date of filing: 05.12.2002

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SI SK TR
Designated Extension States:
AL LT LV MK RO

(30) Priority: 21.12.2001 EP 01310838

(71) Applicants:
- UNILEVER PLC
London EC4P 4BQ (GB)
Designated Contracting States:
CY GB IE
- UNILEVER N.V.
3013 AL Rotterdam (NL)
Designated Contracting States:
AT BE BG CH LI CZ DE DK EE ES FI FR GR IT LU MC NL PT SE SI SK TR

(72) Inventors:
- Malone, Mark Emmett
Sharnbook, Bedford MK44 1LQ (GB)
- Underdown, Jeffrey
Sharnbook, Bedford MK44 1LQ (GB)
- Wix, Loyd
Sharnbook, Bedford MK44 1LQ (GB)

(74) Representative: Hugot, Alain et al
Unilever plc,
Patent Division,
Colworth House
Sharnbrook, Bedford MK44 1LQ (GB)

(54) Frozen aerated confection

(57) Frozen aerated confection having an overrun of above 80% and below 250%, and containing less than 0.5% w/w glycerol, freezing point depressants in an amount of between 25 % and 37 % w/w, and between 2 and 12% fat, wherein the freezing point depressants have a number average molecular weight $<M>_n$ of less than 300 have a soft structure when eaten at -18°C.

EP 1 321 043 A1

Description

Field of the invention

[0001] The present invention relates to a frozen aerated confection which is soft at -18°C and which contains less than 0.5 % (w/w) glycerol.

Background of the Invention

[0002] Trying to produce soft ice creams at -18°C has been the subject of many attempts which are all linked to the use of freezing point depressant compounds which make the product 'softer' by reducing the ice content of the product. GB 2019187 describes various 'soft' ice creams containing sugars and sugar alcohols having a molecular weight of less than 600. More particularly it describes a frozen aerated product, with an overrun of at least 140%, containing glycerol in an amount of 1 to 5%, sorbitol, fructose and invert sugar. GB 2019187 also indicates that as long as those low molecular weight sugars are present in the required quantities, the presence of higher molecular weight sugars has no impact on the 'softness' of the end product.

[0003] In general, these soft compositions present major drawbacks. First of all, owing to the sugars which are used, these products are extremely sweet and require the use of additives to suppress sweetness and/or, the use of very high overrun, and/or the use of significant amounts of glycerol which does not significantly contribute to the sweet taste but which generates a very noticeable off taste which consumers do not like.

[0004] Secondly, in order to try and quantify the softness of the ice cream, GB2019187 uses an Instron test, but it is submitted that this test does not really reproduce the mechanisms which take place in the mouth of a consumer having such an ice cream. It is particularly presented that compositions according to GB2019187 containing high molecular weight sugars are not satisfactory in terms of softness, nevertheless, when tested on Instron according to GB 2019187 they are fully within the teaching of GB 2019187. Therefore, GB 2019187 does not appear to fully resolve the single problem of producing a soft ice cream at typical freezer temperatures eg -18°C or below.

[0005] Therefore, the past attempts to produce ice creams to be consumed at typical freezer temperatures eg -18°C and having a normal overrun while not containing noticeable amounts of glycerol and not exhibiting a sweet taste while having organoleptic characteristics similar to soft ice creams which are typically consumed at temperatures of -8°C or warmer have not been successful.

[0006] There is thus a need for frozen aerated confections which will satisfy these criteria.

[0007] It has now be found that at a given ice content, it is possible to make the product softer by carefully selecting the sugars and particularly by avoiding high molecular weight sugars even in small quantities. It has also been found that, by carefully selecting the sugars, it is possible to make a remarkably soft product without having to use glycerol and without having to use additives to suppress sweetness. It has also been found that, with these new formulations, high overruns, in order to mask the sweetness, are no longer necessary.

Tests and definitions

Average molecular weight

[0008] For the purposes of this patent, the average molecular weight for a mixture of freezing point depressants (fdps) is defined by the number average molecular weight $<M>_n$ shown in the equation below. Where w_i is the mass of species i, M_i is the molar mass of species i and N_i is the number of moles of species i of molar mass M_i.

$$<M>_n = \frac{\sum w_i}{\sum (w_i / M_i)} = \frac{\sum N_i M_i}{\sum N_i}$$

Freezing point depressants

[0009] Freezing point depressants (fpds) as defined in this invention consist of:

- monosaccharides and disaccharides

- Oligosaccharides containing from 3 to ten monosaccharide units joined in glycosidic linkage.
- Corn syrups with a dextrose equivalent (DE) of greater than 20 preferably > 40 and more preferably > 60. Corn syrups are complex multi-component sugar mixtures and the dextrose equivalent is a common industrial means of classification. Since they are complex mixtures their number average molecular weight $<M>_n$ can be calculated from the equation below. (Journal of Food Engineering, 33 (1997) 221-226)

$$DE = \frac{18016}{<M>_n}$$

- erythritol arabitol, xylitol, sorbitol, mannitol, lactitol and maltitol.

Definition of overrun.

[0010] Overrun is defined by the following equation

$$OR = \frac{volume..of..ice..cream - volume..of..premix..at..ambient.temp}{volume..of..premix..at..ambient..temp} \times 100$$

Brief description of the invention

[0011] It is the object of the present invention to provide a frozen aerated confection having an overrun of above 80% and below 250%; preferably above 100%, containing;

- less than 0.5% w/w glycerol
- freezing point depressants in an amount above 25 % w/w and under 37 % w/w, preferably above 26% w/w, more preferably above 27% w/w , and
- between 0 and 15% w/w fat

wherein the freezing point depressants have a number average molecular weight $<M>_n$ of less than 300.

[0012] Preferably, the frozen aerated confection according to the invention contains at least 2% w/w fat.

[0013] Preferably the frozen aerated confection according to the invention contains less than 12% w/w fat, more preferably between 4 and 10% w/w.

[0014] Preferably the freezing point depressants have a number average molecular weight $<M>_n$ below 275 and even more preferably below 250. Even more preferably, the freezing point depressants have a number average molecular weight $<M>_n$ below 230.

[0015] The freezing point depressants are constituted at a level of at least 98% (w/w) of mono, di and oligosaccharides . More preferably, since fructose delivers a very sweet taste, the frozen aerated confection contains less than 5% w/w fructose, even more preferably less than 2.5% w/w fructose.

[0016] Preferably also the frozen aerated confection according to the invention contains less than 0.25% glycerol, even more preferably less than 0.1%. Preferably also, the frozen aerated confection according to the invention contains less than 10% w/w sorbitol, more preferably less than 5% w/w sorbitol.

[0017] Preferably also, the frozen aerated confection according to the invention contains more than 2% and less than 8% w/w proteins, preferably less than 6% w/w since it has been found that too high a protein content leads to a chalky, cheesy texture which should be avoided.

[0018] In a preferred embodiment of the invention the frozen aerated product has an overrun of less than 150%, more preferably less than 140%.

[0019] In another preferred embodiment of the invention the frozen aerated product has an overrun of more than 150%, more preferably more than 170%.

Detailed description of the invention

[0020] The present invention will be further described in the following examples wherein, unless indicated otherwise, the percentages are in weight by weight (w/w).

[0021] It should be noted that in the examples below the SMP (skimmed milk powder) is comprised of 50% (w/w) lactose and this needs to taken into account when calculating the total amount of freezing point depressants and the number average molecular weight $<M>_n$. Similarly, ingredients such as cocoa powder, whey concentrate, chocolate, fruit puree or juice, malt extracts also contain freezing point depressants that contribute to $<M>_n$.

[0022] Various ice creams were formulated and produced as follows and according to the following processing conditions:

[0023] Mixing - all ingredients are combined in an agitated heated mix tank. Once all ingredients have been blended together, the mixture is subjected to high shear mixing at a temperature of at least 65°C for 2 minutes in order to hydrate the stabilisers. Excessive temperature should however be avoided to prevent damage to heat labile components and the formation of cooked off flavours.

[0024] Homogenisation - the mix is then subjected to a homogenisation stage to reduce the bulk of the fat droplets to below 1μm. This is accomplished by homogenising the mixture using a valve homogeniser operating at a pressure of 150bar at a typical temperature of 70°C.

[0025] Pasteurisation - to conform to public health requirements the mix is subjected to pasteurisation treatment. The mix is heated to a temperature of 83°C and held for 20 seconds to achieve satisfactory treatment. The pasteurised mix is then rapidly cooled to chill temperatures, typically 4°C.

[0026] Ageing - The mix is held at chill temperature, typically 4°C.

[0027] The formulations of examples 7 to 12 were frozen using typical ice cream continuous freezers known at votators or scraped surface heat exchangers. These devices serve to freeze the mix and incorporate sufficient air to deliver the desired overrun. Although such devices usually deliver frozen ice cream at temperatures of -5°C to -7°C, the high levels of freezing point depressors in the formulations within this invention meant that the ice creams are typically frozen down to temperatures of -10 to -13°C.

[0028] Following freezing in a votator the ice cream is subjected to hardening process that reduces the temperature of the ice cream close to the final storage temperature.

[0029] Formulations of examples 1 to 6 were transferred from the votator to a cold extrusion device such as a single screw extruder where the ice cream can be further cooled under shear. Due to high levels of freezing point depressors the ice cream formulations disclosed in this invention will leave the cold extrusion device at temperatures of -20°C or lower.

Example	1	2	3	4	5	6
	% (w/w)	% (w/w)	% (w/w)	% (w/w)	% (w/w)	% (w/w)
SMP (Skimmed Milk Powder)	10	10	10	10	10	10
Butterfat	10	10	5	5	10	5
MGP (mono glyceryl palmitate)	0.3	0.3	0.3	0.3	0.3	0.3
LBG (locust bean gum)	0.2	0.2	0.2	0.2	0.2	0.2
Dextrose	15.2	15.2	17.3	15.3	21.7	17.3
Sucrose	7.6		8.65	7.65		
Corn syrup DE=63 83%solids		9.7			5	11
Water	56.6859	54.5859	58.5359	61.5359	52.7859	56.1859
Flavour	0.0141	0.0141	0.0141	0.0141	0.0141	0.0141
Average molecular weight	229	219	227	229	206	220
Overrun	135%	135%	135%	135%	135%	135%

Example	7	8	9	10
	%(w/w)	%(w/w)	%(w/w)	%(w/w)
Butter fat	4	4	4	10
SMP	8	8	8	10
MGP	0.15	0.15	0.15	0.3
Iota Carrageenan	0.2	0.2	0.2	
Vanilla				0.0141

(continued)

Example	7	8	9	10
	%(w/w)	%(w/w)	%(w/w)	%(w/w)
Vanillin	0.01	0.01	0.01	0.01
Sucrose	6.5	8.125	5.0	17.8
Lactose	3.5	4.375		
Dextrose	15.4	19.715	19.375	8.9
Water	62.04	55.22	63.065	52.79
LBG	0.2	0.2	0.2	0.2
Average Molecular weight	233	230	212	273
Overrun	100%	100%	135%	135%

Example	11
	%(w/w)
Coconut oil	7.0
Chocolate	2.0
SMP	3.74
Cocoa powder	7.0
Whey Conc. powder	3.84
Lactose	4.4
Dextrose	23.0
Sucrose	3.0
LBG	0.3
MGP	0.2
Colour	0.4
Water	45.12
Average Molecular weight	216
Overrun	200%

Example	12	13	14
	%(w/w)	%(w/w)	%(w/w)
Butter fat	4	4	4
SMP	8	8	8
MGP	0.15	0.15	0.15
Iota Carrageenan	0.2	0.2	0.2
Vanillin	0.01	0.01	0.01
Sucrose	15.5	11.5	19.27

(continued)

Example	12	13	14
	%(w/w)	%(w/w)	%(w/w)
Corn Syrup DE40	14	10.35	17.4
Water	57.94	65.6	50.77
LBG	0.2	0.2	0.2
Average Molecular weight	380	379	381
Overrun	100%	100%	100%

[0030] Examples 1-11 were considered to be soft and comparable to artisanal soft serve ice creams whereas comparative examples 12-14 were perceived to be much firmer.

Claims

1. Frozen aerated confection having an overrun of above 80% and below 250%, containing;

    - less than 0.5% w/w glycerol
    - freezing point depressants in an amount above 25 % w/w and below 37 % w/w, and
    - between 0 and 15% fat,

    wherein the freezing point depressants have a number average molecular weight $<M>_n$ of less than 300.

2. Frozen aerated confection according to claim 1 containing between 2% and 12% fat.

3. Frozen aerated confection according to claim 1 or 2 wherein the freezing point depressants have a number average molecular weight $<M>_n$ below 275.

4. Frozen aerated confection according to claim 3 wherein the freezing point depressants are constituted at a level of at least 98% (w/w) of mono, di and oligosaccharides .

5. Frozen aerated confection according to claim 4 containing less than 5 % w/w fructose.

6. Frozen aerated confection according to claim 1 containing less than 0.25% (w/w)glycerol, preferably less than 0.1% (w/w).

7. Frozen aerated confection according to claims 1 to 6 containing more than 2% and less than 8% proteins.

8. Frozen aerated product according to claims 1 to 6 having an overrun of less than 150%, preferably less than 140%.

9. Frozen aerated product according to claims 1 to 6 having an overrun of more than 150%, preferably more than 170%.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 25 8414

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 4 244 977 A (KAHN MARVIN L ET AL) 13 January 1981 (1981-01-13) * column 9, line 27,28 * * column 12, line 61-68; example *	1-9	A23G9/02
D,X	GB 2 019 187 A (UNILEVER LTD) 31 October 1979 (1979-10-31) * page 1, line 34-36; example 5 * * abstract *	1-9	
X	EP 0 941 668 A (NIKKEN CHEMICALS CO LTD) 15 September 1999 (1999-09-15) * paragraphs '0035!-'0043!,'0091!,'0130!; claims * * page 8 *	1-9	
X	US 4 346 120 A (MORLEY ROBERT G ET AL) 24 August 1982 (1982-08-24) * column 7, line 43-45; example 1 *	1-9	
X	US 4 376 791 A (HOLBROOK JAMES L ET AL) 15 March 1983 (1983-03-15) * column 3, line 53-62; claims; examples *	1-9	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			A23G
A	GB 1 519 294 A (UNILEVER LTD) 26 July 1978 (1978-07-26) * example 1 *	1-9	
A	FR 2 745 153 A (RIVEIRE SILVENTE ET ASSOCIES R) 29 August 1997 (1997-08-29) * the whole document *	1-9	
A	US 4 145 454 A (DEA IAIN C M ET AL) 20 March 1979 (1979-03-20)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	1 April 2003	Boddaert, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 25 8414

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-04-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4244977 A	13-01-1981	US 4146652 A	27-03-1979
		US 4154863 A	15-05-1979
		US 4199604 A	22-04-1980
		AU 3281278 A	02-08-1979
		BE 863403 A1	27-07-1978
		CA 1107120 A1	18-08-1981
		DE 2803634 A1	03-08-1978
		DE 2857879 C2	08-01-1987
		DE 2858023 C2	08-09-1988
		DE 2858058 C2	24-01-1985
		DE 2858206 C2	21-04-1988
		DE 2858207 C2	08-10-1987
		DK 40078 A ,B,	29-07-1978
		DK 504084 A ,B,	22-10-1984
		ES 466336 A1	01-04-1979
		ES 475156 A1	01-06-1979
		FI 780232 A ,B,	29-07-1978
		FI 831168 A ,B,	06-04-1983
		FR 2378456 A1	25-08-1978
		GB 1548358 A	11-07-1979
		IL 53713 A	31-07-1981
		IT 1092000 B	06-07-1985
		JP 1187324 C	20-01-1984
		JP 53104767 A	12-09-1978
		JP 58020250 B	22-04-1983
		JP 1213082 C	27-06-1984
		JP 58047143 B	20-10-1983
		JP 58047450 A	19-03-1983
		MX 6157 E	29-11-1984
		NL 7801039 A ,B,	01-08-1978
		NL 8303364 A ,B,	01-02-1984
		NL 8303365 A	01-02-1984
		NL 8303366 A ,B,	01-02-1984
		NL 8303367 A ,B,	01-02-1984
		NL 8303368 A ,B,	01-02-1984
		NZ 186140 A	17-08-1982
		NZ 197393 A	17-08-1982
		SE 439577 B	24-06-1985
		SE 7800962 A	29-07-1978
		US 4244976 A	13-01-1981
		US 4308287 A	29-12-1981
		US 4234611 A	18-11-1980
		US 4237146 A	02-12-1980
		US 4350711 A	21-09-1982
		US 4199605 A	22-04-1980

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 25 8414

This annex lists the patent family membersrelating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-04-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2019187 A	31-10-1979	AT 375817 B	10-09-1984
		AT 306879 A	15-02-1984
		AU 532829 B2	13-10-1983
		AU 4640979 A	01-11-1979
		BE 875826 A1	24-10-1979
		CA 1117355 A1	02-02-1982
		CH 652567 A5	29-11-1985
		DE 2916395 A1	31-10-1979
		DK 166879 A	25-10-1979
		ES 479892 A1	16-08-1980
		FR 2423986 A1	23-11-1979
		IE 48114 B1	03-10-1984
		IT 1118967 B	03-03-1986
		LU 81186 A1	07-11-1979
		NL 7903236 A	26-10-1979
		PT 69543 A	01-05-1979
		SE 7903559 A	25-10-1979
		US 4219581 A	26-08-1980
		ZA 7901935 A	26-11-1980
EP 0941668 A	15-09-1999	JP 10117763 A	12-05-1998
		JP 3371063 B2	27-01-2003
		JP 10117693 A	12-05-1998
		JP 3371064 B2	27-01-2003
		JP 10117694 A	12-05-1998
		EP 0941668 A1	15-09-1999
		WO 9816120 A1	23-04-1998
US 4346120 A	24-08-1982	US 4400405 A	23-08-1983
		US 4400406 A	23-08-1983
		US 4427701 A	24-01-1984
US 4376791 A	15-03-1983	CA 1174894 A1	25-09-1984
GB 1519294 A	26-07-1978	NONE	
FR 2745153 A	29-08-1997	FR 2745153 A1	29-08-1997
		AT 200609 T	15-05-2001
		AU 1928897 A	10-09-1997
		CA 2247097 A1	28-08-1997
		CN 1211900 A ,B	24-03-1999
		DE 69704610 D1	23-05-2001
		DE 69704610 T2	06-12-2001
		DK 878998 T3	13-08-2001
		EP 0878998 A1	25-11-1998
		ES 2159112 T3	16-09-2001

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 25 8414

This annex lists the patent family membersrelating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-04-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2745153 A		WO 9730600 A1	28-08-1997
		GR 3036236 T3	31-10-2001
		JP 2000506004 T	23-05-2000
		NO 983895 A	23-10-1998
		PT 878998 T	30-10-2001
US 4145454 A	20-03-1979	GB 1599272 A	30-09-1981
		AT 375530 B	10-08-1984
		AT 710077 A	15-01-1984
		AU 2935177 A	12-04-1979
		CA 1109319 A1	22-09-1981
		CH 633943 A5	14-01-1983
		DE 2744614 A1	13-04-1978
		DK 441377 A	07-04-1978
		ES 462944 A1	16-12-1978
		FR 2366799 A1	05-05-1978
		IE 46049 B1	09-02-1983
		IT 1091182 B	26-06-1985
		LU 78266 A1	09-06-1978
		NL 7710960 A	10-04-1978
		PT 67121 A ,B	01-11-1977
		SE 426774 B	14-02-1983
		SE 7711172 A	07-04-1978
		SE 426782 B	14-02-1983
		SE 426775 B	14-02-1983
		SE 426781 B	14-02-1983
		SE 426784 B	14-02-1983
		SE 426779 B	14-02-1983
		SE 426783 B	14-02-1983
		SE 426778 B	14-02-1983
		SE 426776 B	14-02-1983
		SE 8104686 A	06-02-1983
		SE 426777 B	14-02-1983
		BE 859322 A1	03-04-1978

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82